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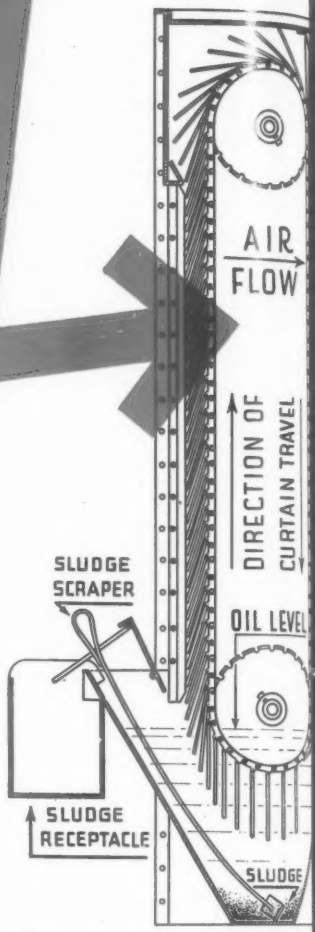

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FOUNDRY TRADE JOURNAL

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Apprentice Competitions

It is interesting to learn that invitations have been issued to the moulding and coremaking apprentices of this country to participate in a European competition*. The winner is to be designated the "best apprentice moulder/coremaker." We deplore this designation as it unjustifiably implies a total participation. Surely a better appellation is the good old fairground term of "champion." If this be not acceptable, then "international trophy winner" is suggested. What is noteworthy is that this country has no background of organizing a national competition. Some districts, however, have a wealth of experience and this is being rapidly developed year by year, and, moreover, the interest evinced continues markedly to increase.

There are many snags to be overcome, as for instance, during the closing stages of one competition—actually on the arrival of the cores at the foundry—it was discovered that a group of boys intended to make magnesium castings, for which the cores supplied were quite unsuited. In this European contest, no specific mention is made of this metal. In the last competition organized by the Tees-side foundrymen, there was a section devoted to written papers, and it is interesting to note that of the three winners, only the name of one figures amongst those gaining an award in the practical tests. The European contest allows twelve hours for the practical test and seven and a half or nine if "General Knowledge and Composition" be included. It would appear, though it is not too clear, that all candidates must sit for this last subject, but it will only be marked in case of a tie.

We think a test, which includes technology, drawing and calculations, each presumably carrying 20 points—though no figure is given for drawing—as against 100 for the practical work, weights the contest in favour of the handy "bookworm" and against the budding brilliant craftsman to whom theory does not greatly appeal. However, the object of the competition may be to find an outstanding *foundry* apprentice and not specially a brilliant neophyte moulder or coremaker, or to quote the terms of the rules the "best apprentice moulder/coremaker". Because this country lacks experience on a national basis, it must rely for advice on those already well versed on the subject. The organization of a British national competition would be alike onerous and expensive, but the time is now ripe for its serious consideration by the employers' organizations. It is a subject which should be placed high on the agenda, when time and place is found for a meeting of the heads of major foundry associations, for it is a matter which concerns every section of the industry.

* Details of this competition are published on p. 109 of this issue

BSCRA Information Liaison with US Steelfounders

The British Steel Castings Research Association announces that it has entered into an arrangement with the Steel Founders' Society of America for the exchange of information at their respective annual conferences. Each association will, in alternate years, invite the other to nominate a speaker to address its annual conference on a selected subject. The scheme is being initiated this year with an invitation from the SFSA for representatives of the BSCRA to address their technical and operating conference in Cleveland, Ohio, November 11-13, on the subject of the application of graphite-rod resistor furnace to steelfoundry practice, and the use in steel foundries of the immersion pyrometer for the measurement of liquid-steel temperatures.

The British research association has nominated Mr. T. A. Cosh, head of its steelmaking section, and Mr. L. W. Sanders, chief metallurgist, Lake & Elliot Limited, to present this paper, their two organizations being the first in this country with experience of the graphite-rod resistor furnace for the production of steel. Mr. Cosh and Mr. Sanders expect to leave for the United States at the end of October and to include visits to a number of steel foundries and metallurgical-research organizations in their itinerary.

ECSC Fines Dutch Firm for Price Rule Infringement

An announcement by the European Coal and Steel Community states that a Dutch firm has been fined 40,000 florins (about £4,000) for an offence against the rule of non-discrimination in prices.

The High Authority has also made an order for the recovery of 50,000,000 francs (£50,000) against a French steel firm, which has not paid its contribution to the levy on scrap. The levy is used to bring down the price of community scrap to the level of internal prices of scrap in member countries.

Lifting Magnets for India

This consignment of magnets, valued at £20,000, is being loaded at the works of the General Electric Company, Limited, for despatch to the Indian Iron & Steel Company, Limited. These magnets are some of the largest built. Each is 65-in. dia., weighs 6¼ tons, uses 30 kw of power, and can lift 30 tons of steel ingots or slabs.

BSFA Essay Competition

The British Steel Founders' Association at its recent annual meeting held in London, distributed the prizes awarded on the result of an essay competition organized to cover the following subjects:—(*a*) Production and the foundry foreman; (*b*) design for castability; (*c*) incentives; (*d*) non-destructive testing; (*e*) foundry sands; and (*f*) works safety. The first prize of £50 was awarded to Mr. A. W. Scott (Jarrow Metal Industries, Limited) for his entry entitled "Discussion of the Impact of Modern Methods of Production and Supervision on the Functions of the Foundry Foreman." The second prize of £25 went to Mr. R. F. Cornell (Lake & Elliot, Limited); his subject was "Production." The third prize was shared by Mr. G. French (K. & L. Steelfounders & Engineers, Limited) for his essay on "Non-destructive Testing," and Mr. P. B. A. Willis (William Jessop & Sons, Limited) whose subject was "Inspection and Testing"; each received £10.

Special awards went to the following:—Mr. J. Bell (Clyde Alloy Steel Company, Limited); Mr. W. Cumming (Clyde Alloy); Mr. R. Davis (K. & L. Steelfounders & Engineers, Limited); Mr. E. Green-Spikesley (English Steel Castings Corporation, Limited); Mr. W. Hamilton (Clyde Alloy); Mr. B. F. Olds (North British Steel Foundry, Limited); Mr. G. Perkins (Catton & Company, Limited); Mr. A. Priest (English Steel); Mr. R. A. Short (Edgar Allen & Company, Limited); Mr. P. O. Stammers (Lake & Elliot, Limited); Mr. R. A. West (Edgar Allen); and Mr. A. E. Young (Lake & Elliot). All competitors submitting essays received an award of two guineas. The response to the invitation to compete was particularly encouraging and with the winning contribution better than the average, it shows there is still a large reservoir of useful information to be gleaned from study of the entries. It is to be hoped that they will not just be filed for reference.

Textile Machinery Exhibition at Manchester

Scientific, technological, and engineering advances made in the last four years will be reflected in the new machinery and improved methods on show at the fifth in the post-war series of international textile machinery exhibitions at Belle Vue, Manchester, from October 15 to 25, 1958. Participation is open to manufacturers in all countries of machinery, accessories, and ancillary equipment used in the production of textiles (excluding knitted goods).

Inquiries should be sent to Textile Recorder Exhibitions, Limited, Old Colony House, South King Street, Manchester, 2 (telephone: Deansgate 6903).

Forty Years Ago

In the July, 1917, issue of the FOUNDRY TRADE JOURNAL a "grouse" was expressed editorially that the boys entering the foundry industry were not being properly trained, but were used as cheap labour. Today, these same boys (now men of 50 years or more) are being referred to as the backbone of the trade and it is the younger men who are not so skilful. Amongst new companies registered appeared the name of A. and R. Mason of Deptford; Alder and Mackay, Edinburgh; and the Renishaw Iron Company.

A NEW oxygen compressing station at Mosley Road, Stretford, is to be built by British Oxygen Gases, Limited, to meet demands for the gas in Manchester.

British Steel Castings Research Association

Abstract from Fourth Annual Report, Covering the Year's Activities to March 31

The following abstract has been prepared from the recently-issued annual report of the British Steel Castings Research Association. As far as the research programme itself is concerned, it is pointed out that research progress during the latter half of the year under review has been inevitably limited by the transfer of the Association's headquarters from Broomgrove Lodge to the Research Station at East Bank Road. Although this transfer took place on December 1, 1956, the new laboratories were not fully equipped and all services provided until the beginning of February, 1957. Apart, therefore, from a few investigations which were being carried out on the premises of member-firms, little investigational work was carried out between the middle of November, 1956, and the beginning of February, 1957.

Nevertheless, it is possible to report substantial progress in the experimental work over the year as a whole. Twenty-four projects comprised the Association's research programme for 1956-57, and of these seven have been completed and, consequently, do not feature in the programme for 1957-58. In several other projects appreciable progress has been made leading to the expectation that these will be completed in 1957-58, or will open up new lines of investigation deserving further study.

GENERAL

The year ended March 31, 1957, has marked an important stage in the evolution of the Association and the Council is pleased to report that the new offices and laboratories in Sheffield are now fully operational. The Association's staff has been built up to a level which will enable the laboratories to be operated at maximum efficiency, and an investigational programme to be prosecuted for the first time on a scale realistically related to the technical needs of the steelfounding industry. There has been a further increase in the total membership of the Association and over 80 per cent. of eligible steel founders in Great Britain, together producing about 85 per cent. of the total tonnage of steel castings made by the industry, are now members.

Membership

The following four companies have been elected as ordinary members of the Association during the year:—Brockhouse Castings, Limited; Clarke, Chapman & Company, Limited; Davies & Baird Pty., Limited; and John Fowler & Company (Leeds), Limited.

At an extraordinary general meeting of members in 1956, Article 5 of the Articles of Association was amended to permit persons and corporate bodies who are engaged in the production and marketing of materials, machinery, etc., used in the steelfounding industry to be admitted to membership of the Association as associate members. The following companies have been elected as associate members during the year:—August's, Limited; Foundry Services (Holdings), Limited; and Spencer & Halstead, Limited.

Finance

The income of the Association has risen during the year as a consequence of the increase in membership during 1955-56, and the contribution from the industry is now substantially in excess of that required to secure the maximum grant from the Department of Scientific & Industrial Research.

As in previous years, the subscription income of the Association has been supplemented by a contribution from the British Steel Founders' Association, provided in order to assist the Association in financing work in the field of industrial health. However, in order to remove certain anomalies resulting from the fact that membership of the two Associations is not identical, the Council has agreed with the Executive Council of the British Steel Founders' Association that the BSCRA will, in future, obtain by direct subscription from its members the sum of money previously provided by the British Steel Founders' Association from their industrial health fund. This proposal will involve an alteration in the basis of computation of subscriptions, and it is the intention of the Council to submit to the next annual general meeting proposals to this end. These will ensure that, for any members who formerly contributed to both the BSCRA and the BSFA industrial health fund, the rate of subscription per unit of wages paid will not be increased.

During the year a contribution has been made to the funds of the Association by Imperial Chemical Industries, Limited, Billingham and Alkali Divisions, who are supporting jointly with the Association the work at Reading University under Dr. P. F. Holt on the biochemical aspects of silicosis. A small income has also been received during the year from the sale of the BSCRA exposure calculator for gamma radiography.

The expenditure of the Association during the year has been controlled to a value close to the budgeted limit. The result is considered to be very satisfactory, since the financial year has included four months of occupation of the new laboratories, the operating costs of which could not be forecast with any degree of certainty at the time when the budget was drawn up. The expenditure has also included the cost of X-ray diffraction equipment and accessories, for which no special provision had been made in the original estimate of expenditure.

In spite of rising prices and the several minor readjustments to the original plans necessitated by considerations arising after building has been commenced, the cost of the laboratories and the installed equipment has been kept within the original estimate. The total cost of the buildings

British Steel Castings Research Association

has been capitalized in the Balance Sheet at £59,793. This figure compares with an estimated cost of £57,115. The cost of equipment at £33,514 (compared with an estimated cost of £36,557) is shown in the income and expenditure account as it is the Council's policy not to capitalize assets of this nature. The Council places on record its appreciation of the effective control exercised by the finance committee and the careful planning of the research station committee and the permanent staff during the whole period of construction of the new premises.

The payments which have been made on account of the new premises, coupled with the fact that £13,750 of DSIR grant is not payable until some months after the end of the financial year, depleted the Association's cash resources. The Council has, therefore, gratefully accepted a generous offer made by Lake & Elliot, Limited, of an interest free, unsecured, loan of £10,000, during the next few months.

Research Station

The experimental foundry, ancillary laboratories and administrative offices are now fully operational. The main steel-making furnace is a basic-lined graphite-resistor rod furnace of 6 cwt. capacity. This, and the other foundry equipment, is of sufficient size to ensure that conditions in the experimental foundry approximate sufficiently closely to production conditions, to enable certain aspects of the Association's work to be translated to member foundries with the optimum chance of success. Grouped around the foundry are the machine shop, chemical, sand-testing and metallurgical laboratories and the mechanical test house. The dust laboratory is housed in a separate building to minimize atmospheric contamination by processes carried out in the foundry.

The occupation of the research station has enabled the Association to vacate the premises of Edgar Allen & Company, Limited, in which work has been in progress for some years on dust suppression and control. The Council has placed on record its indebtedness to the chairman and directors of Edgar Allen & Company, Limited, for the provision of these facilities, which have greatly contributed to this important aspect of the Association's work. Most of the requirements for chemical analysis can now also be met in the Association's own analytical laboratory, whereas previously this work had been carried out in the Metallurgy and Refractories Departments at Sheffield University, by arrangement with the University authorities. The Association expresses its gratitude to Professors A. G. Quarrell and J. White for the provision of these facilities.

Staff

To match the acquisition of much improved facilities for experimental investigation, there has been a corresponding increase in the staff of the Association, which now totals 47, exclusive of part-time staff and University bursars.

Technical Advisory Committees

In view of the growing importance of the Association's work in the field of industrial health and the need for close liaison with the British Steel Founders' Association on this subject, a new committee has been constituted with the title "BSCRA/BSFA Joint Technical Advisory Committee on Industrial Health" and with the terms of reference "To advise the Director of Research (BSCRA) and the respective Councils of the BSCRA and BSFA on technical matters in the field of industrial health." The Association's representatives on this committee are Brigadier A. Levesley, Dr. R. Hunter and Mr. R. F. Horton. Brigadier Levesley has been elected chairman of this committee, which has held two meetings.

In order to further a standardization in the steel-founding industry of methods used for the magnetic particle inspection of castings, the Association's general metallurgy committee constituted during the year a sub-committee under the chairmanship of Mr. J. Blackburn, to consider available techniques and to recommend those best suited for this purpose. This sub-committee has held three meetings and will issue its recommendations in the near future.

Conferences and Meetings

A very successful conference was held at York on October 25-26, 1956, on the subject of "Steel-foundry Moulding Materials." This was attended by 131 delegates representing 80 per cent. of the Association's membership in this country. Ten papers were presented at six sessions. These papers, together with summaries of the ensuing discussions, have been printed in the Association's *Journal*. The Council is convinced that such conferences provide an effective means of bringing the Association's work to the attention of the industry, as well as providing a forum for the discussion of common technical problems. It is proposed to make a conference of this type a regular annual event.

Liaison with Members

During the year the advisory services have involved 62 visits by the Association's staff to members, and, in addition, a large number of enquiries has been dealt with by correspondence. It is the hope of Council that the relatively few members of the Association who are not at the present time using these facilities will do so in future, since they contribute materially to close personal contact between the Association's staff and the staff of members.

Extramural Research

It is not intended to curtail research which the Association sponsors at Universities as a consequence of the occupation of the new laboratories. During the year funds have been provided for bursars working at Cambridge, Reading and Sheffield Universities under the direction of Dr. T. P. Hoar, Dr. P. F. Holt and Professor J. White respectively. The Association has also contributed to

the cost of an investigation conducted by the British Electrical & Allied Industries Research Association on the high-temperature properties of cast steels, and information on the progress of this investigation has been made available to interested members during the year.

DSIR Visitors

The Department of Scientific and Industrial Research has appointed as Visitors to the Association Professor G. Wesley Austin, O.B.E., M.SC., F.I.M., Professor of Metallurgy at the University of Cambridge, and Dr. C. J. Smithells, M.C., F.I.M., managing director of Magnesium Elektron, Limited. Professor Wesley Austin and Dr. Smithells have visited the laboratories and have discussed the Association's activities with the director and senior members of the staff.

Library and Publications

The total number of publications in the library, excluding trade catalogues, is now well in excess of 5,000 and the name and subject indexes each comprise more than 12,000 entries.

The Association's bi-monthly *Journal* and *BSCRA Abstracts* have been published regularly during the year. Each issue of *BSCRA Abstracts* has contained summaries of approximately 150 papers. The *Journal*, in addition to a number of general articles, also contained reprints of all the papers which were submitted to the Association's conference on "Steel Foundry Moulding Materials" and the discussion of these papers.

External Relations

The Association has continued to maintain friendly contact with steelfoundry organizations throughout the world. Relations with the Steel Founders' Society of America have been particularly cordial and, while both organizations are concerned with safeguarding the interests of their members, it has been possible to exchange much helpful technical information. The Steel Founders' Society of America have assigned to the BSCRA the right to apply for British Letters Patent covering an invention relating to sand mixtures for shell moulding, together with the development rights in this country. Arrangements have also been approved by the Councils of both Associations for the exchange of speakers in alternative years to their respective annual conferences. Arising from this arrangement a nominee of BSCRA will attend the Steel Founders' Society of America annual conference in Cleveland, Ohio, in November.

Close contact has been maintained with the British Steel Founders' Association. Reference has already been made to the Joint Committee set up between BSCRA and BSFA to maintain liaison in matters relating to industrial health. The director is also a member of the BSFA committees on industrial health and on specifications. The directors of both Associations hold regular meetings for joint consultation.

METALLURGY

Simulation Technique

The analogy between the solidification characteristics of steel and stearin wax is fairly well known, and a programme of work has been carried out to assess the suitability of stearin-wax models for solving feeding problems in steel castings. Direct comparative studies have been made between low-carbon steel castings and wax castings of the same shape and size, made under varying experimental conditions.

The results have been encouraging and have demonstrated that good simulation is obtained for small castings of simple shape, if the wax is poured at a low temperature. The castings consisted of a number of similar rectangular blocks, surmounted by feeder heads of varying dimensions, and a series of L and X junctions in which slight modifications to the casting design had a profound effect on the size and distribution of the shrinkage cavities. In all cases the trends observed in the steel castings were reproduced in stearin wax when the latter was cast as near the freezing point as possible, although generally the shrinkage cavities in wax tended to be larger (wax having a 2 per cent. greater volume contraction on solidification than has steel). With wax pouring temperatures greater than 2 to 3 deg. superheat (pure stearin freezing at 53.8 deg. C.) the analogy was not as good and in some cases was misleading. No better analogy has been obtained by using "alloys" between stearin and other waxes soluble in stearin, *e.g.*, naphthalene, in which freezing is extended over a range of temperature.

When the wax is cast at a temperature very close to its freezing point, the similarity between the distribution of unsoundness in wax and steel is very close. If, however, the wax is cast at a temperature of 60 deg. C. (approximately 6 deg. C. above the freezing point), the simulation is poor.

Measurement of Microporosity and its Effect on the Mechanical Properties of Steel Castings

Work has continued to establish a suitable method for measuring microporosity. The methods studied have included radiography, microscopy, determinations of density and ductility and ultrasonic examination. It has been concluded that comparative ductility measurements, using either elongation or reduction of area as criteria, constitute the most convenient test.

Fig. 1 illustrates an investigation which has been made of a steel casting, the section of which is shown on the left. Specimens numbered 1-14 were taken from the positions indicated. The diagrams (Fig. 1, right) show the variations of ductility and density across the section at positions near the top and the bottom of the relatively sound portion of the casting. It will be seen that the ductility decreases from the outside to the centre of the section in both positions, but that this decrease is much less marked at the bottom of the casting. The density, on the other hand, shows no such smooth variation across the section and,

British Steel Castings Research Association

towards the bottom of the casting, does not even show a minimum at the centre where feeding during solidification is known to be more difficult than at the surface of the casting. Although the reason for the apparently anomalous variation of density is not clearly understood, it appears obvious that ductility shows a much better correlation with the known facts about the distribution of finely dispersed unsoundness in castings.

Magnetic Properties of Cast Steel

The effect of heat-treatment, carbon content and residual-alloy content on the magnetic properties of cast steel has been measured. It has been shown that magnetic properties superior to those obtained by full annealing may be obtained by slowly cooling through the critical range of temperature and then air cooling. The order of magnitude of the improvement is illustrated in Table I, in which some representative values are compared with expected values given in B.S. 1617. This procedure, while producing higher values of permeability, also offers economy in furnace time and is already being used by some member-firms.

Tests have been completed to determine the effect of small residual amounts of nickel, chromium, molybdenum, tin, copper, and lead, on the magnetic permeability, which is decreased by residual contents of all these elements. Tests have also been made on cast steel containing higher manganese contents than the limiting amount of 0.5 per cent. given in B.S. 1617, to determine the extent to which increasing manganese impairs the magnetic properties.

Valuable assistance has been given by Edgar Allen & Company, Limited, and William Beardmore & Company, Limited, in carrying out this work.

Boron-treated Steel Castings

Results on the first part of this investigation dealing with low carbon 0.5 per cent. molybdenum steels were summarized in last year's annual report. In the later study, boron additions were made to cast steels with 1½ per cent. Mn, 1½ per cent. Mn/Mo, 1½ per cent. Cr/Mo and 1½ per cent. Ni/Cr/Mo. The hardenability of each type of steel, as determined by the Jominy end-quench test, was increased particularly in the case of the 1½ per cent. Mn/Mo-type of steel.

Fig. 2 shows the marked effect of boron in improving the hardenability of a 1½ per cent. Mn/Mo steel. The curves shown are standard Jominy end-quench curves in which the Vickers hardness is plotted as a function of the distance from the quenched end of the bar.

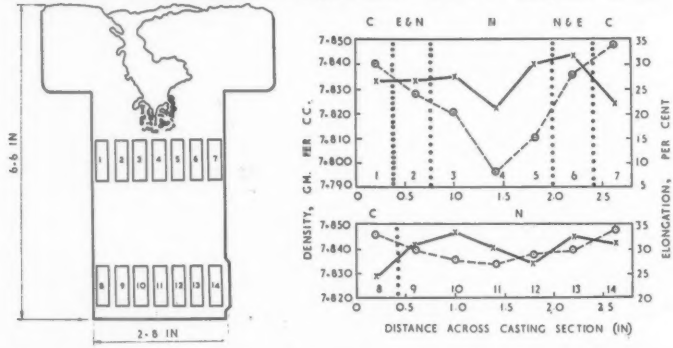

FIG. 1.—*Variations in ductility and density* in specimens cut from positions near the top and the bottom of an ingot-shaped test-block, indicated on the left of the illustration. C = columnar; E = equiaxial; N = nuclear.*

* Density variations are represented by a full line, whilst ductility (elongation, per cent.) is shown by a broken line.

FOUNDRY PROCESSES AND MOULDING MATERIALS

Temperatures at the Metal/Mould Interface in Steel Founding

This work is in progress in the Metallurgy Department of Cambridge University. A study is being made of the temperature at the interface between steel and compacted sand when molten steel comes into contact with relatively cool sand. Problems of metal penetration, oxidation, mould stability and rate of cooling all involve a knowledge of the temperature at the metal/mould interface from the moment when metal comes into contact with a mould wall until complete solidification of the casting has taken place. There is very little firm experimental knowledge of the temperature and the temperature changes during the first few seconds and minutes of contact between metal and mould.

Electronic apparatus has been

TABLE I.—*Representative Magnetization Values, Comparing those Resulting from Different Furnacing Treatments with Expected Values given in B.S. 1617.*

Flux density (B) gauss.	Magnetizing field (H), oersted					
	B.S. 1617.		New heat treatment procedure.	F.C. to 300 deg. C. (annealed).	F.C. to 700 deg. C. and A.C.	A.C. from 950 deg. C. (normalized).
	Grade A.	Grade B.				
10,000	8	10	5.7	6.2	7.7	9.5
14,000	20	28	16.5	19.0	22.0	35.5
15,000	30	40	25.0	29.0	31.0	63.0
17,000	85	110	70.0	78.0	81.0	—
18,000	—	—	120.0	133.0	128.0	—

F.C.—Furnace Cooled. A.C.—Air Cooled.

designed and made to measure temperature by thermocouples at the metal/mould interface, and also at positions immediately below the interface, within the sand. The apparatus provides an automatic photographic record by means of a recording cathode ray oscilloscope.

Conditions at the metal/mould interface are stimulated in the laboratory by pouring a small quantity of molten steel or iron on to a relatively cool specimen of compacted sand, and then supplying heat through the metal layer by means of a high-temperature heater placed immediately above it. Initial melting of the metal is by high-frequency induction. The high-temperature heater is made of graphite to which current is supplied through water-cooled copper connectors.

High-temperature Properties of Mould Refractories

Two aspects of the effect of heat on the properties of moulding materials have been investigated. First, the strength properties of clay-bonded sands at elevated temperatures have been determined, and it has been shown that with slow rates of heating a peak strength develops at a temperature dependent upon the sintering characteristics of the clay bond, *i.e.*, the higher the sintering point of the clay the higher is the temperature at which the peak strength occurs. The significance of this peak in practice has been studied, and it is suggested that it can have little effect on hot tearing, as the sand at the mould/metal interface is heated too rapidly for the strength to increase to any marked extent while the sand is at a high temperature. The temperature at which the peak develops can, however, have some effect on "knock-out" properties, as sand heated to a temperature above that corresponding to the peak contains a considerable amount of liquid which, on cooling, freezes and gives a very high retained strength to the sand. The use, therefore, of a more refractory clay, *e.g.*, a kaolinite, instead of bentonite, in a silica or zircon sand-mix will cause the peak to occur at higher temperatures, thereby reducing the amount of sintered material and, consequently, the strength on cooling. Breakdown of the mixture during knockout will thereby be facilitated.

The second part of the work has been concerned with determining the factors which influence the rates at which clays decompose on heating. It has been established that, when clays alone are compacted or placed in an atmosphere of steam, their decomposition rates on heating are much less when they are heated in powdered form in air. When clays are mixed with sands, the same conditions apply but their decomposition rates on heating are faster than those of the clay alone, this being attributable to the thinness of the clay films in the sand mixtures and the higher porosity of these mixtures. This latter work will, it is hoped, lead to a better understanding of the factors affecting the "life" properties of clays and foundry sands in practice.

Reconditioning of Used Moulding Sands

This work is an investigation of a report in an American publication that used foundry sands could be rejuvenated by making suitable alkali additions. New clay-bonded sands were heated to temperatures at or near to the decomposition point of the clay, cooled and milled with a sodium-carbonate addition, this cycle being repeated four times. On each occasion it was found that the alkali addition caused some improvement in green-strength properties compared with other samples not treated with the alkali, although the improvement was not sufficient to compensate completely for the loss in strength resulting from the previous heating. Tests were then carried out on used foundry sands from member foundries to see if alkali additions would improve the properties of these. It was found generally that an addition of 0.1 per cent. sodium-carbonate improved the green strengths of the sands by approximately 15 to 30 per cent., but that the effects on dry strengths were most inconsistent. No direct correlation could be found between the variation in the pH of the used sands and their bonding properties. Casting trials will be carried out on the treated sands to see if they reveal any differences not shown by the normal room-temperature sand-testing methods.

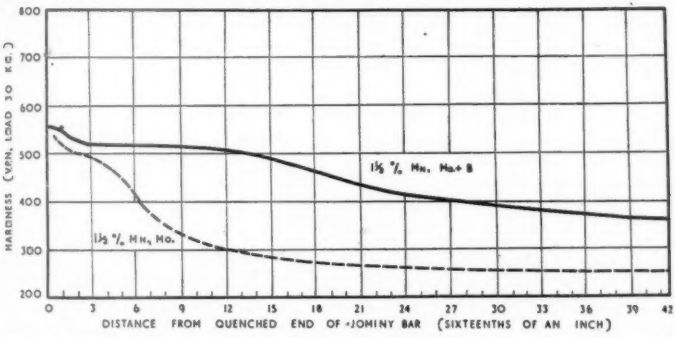

FIG. 2.—*Illustrating the marked effect of boron in improving the hardenability of a 1½ per cent. Mn/Mo steel.*

Sodium-silicate Sand Mixtures for Shell Moulds

An investigation has been made of the possibility of using the thermal hardening of sodium-silicate instead of the thermo-setting resin to bond silica sand for shell moulds. The effects on bond strength of the composition and quantity of the silicate, the size grading of the sand and the temperature and time of curing, have been examined. The results have been very encouraging and are being supple-

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mented by a study of methods of producing shells in these mixtures which cannot be satisfactorily dumped. Casting trials with castings of varying section are also to be made.

CO_2 Process for Hardening Moulds and Cores

Some commercial sodium-silicate binders contain a sugar-type addition and it has been stated that the function of this addition is to increase the collapsibility of the sand at high temperatures, and also after cooling. To investigate this point the hot-strengths and strengths on cooling back of sands bonded with ordinary sodium-silicates containing a sugar (syrup) addition have been determined. The results indicate that this addition has little effect on the form of the hot-strength curve, except at low temperatures, and does not affect the breakdown on cooling back. This was found to be the case over a wide range of soaking times prior to cooling.

Measurements of hot compressive strength for identical sand mixtures containing 5 per cent. of sodium-silicate with and without an addition of 0.5 per cent. of sugar indicate that the sugar addition had little effect on the form of the hot-strength curve and both sands had virtually no strength above 700 deg. C. It has also been found that the sugar addition did not improve the breakdown properties of the sand on cooling down.

Attempts have also been made to confirm the findings reported by other workers that with CO_2/sodium-silicate-bonded sands a secondary increase in hot strength occurs at temperatures over 800 to 900 deg. C. If this is so, it would have an important bearing on the hot-tearing propensities of these mixes. However, no evidence of such an effect was found, either with or without organic additives. Even after long soaking periods the silicate-bonded sands have virtually no strength above 700 deg. C.

Further work on the influence of the soda : silica ratio and solids content of sodium-silicate on hardening with CO_2 has shown that highly viscous silicates of high-solids content give poor strength on hardening. Dilution of the silicate gave a progressive increase in strength up to a maximum.

Kaolinitic Clays

Following earlier limited foundry trials in which it was shown that ball clay/bentonite mixtures had certain advantages over bentonite alone when used as a bond, extensive trials in a member foundry have been in progress for nearly a year. An entire section of the foundry has been operating with a ball clay/bentonite-bonded sand. The section makes small green-sand castings of average weight 50 lb., and up to 450 boxes may be cast per day. So far over 750 tons of castings have been made in the mix and casting quality is reported to be as good as that obtained previously when using a straight bentonite mix. Bond costs are some 22 to 33 per cent. lower than before. These trials are to continue with perhaps an extension of the use of these clay mixtures in other foundries.

The potential importance of this project is very considerable. A 20 per cent. saving in bond cost by all members using synthetic-sand mixtures would result in a total saving to the industry of approximately £20,000 per annum.

Mould- and Core-bonding Agents

Bonding materials examined during the last year have been mainly bentonites. These have originated from a wide variety of sources, including Pakistan, India, Greece and Hungary. Some were found to be quite as good as Wyoming bentonite in bonding properties. A number of Wyoming bentonites from different suppliers have also been examined but exhibit little variation in properties.

Possible corebinders examined were tall oils and poly unsaturated acids from marine oils. These were found to have bonding properties much inferior to linseed oil.

STEELMAKING

Oxygen Injection in Basic Arc-furnaces

Data concerning 42 heats have been obtained from a survey of oxygen-injection practice in the works of member-firms. Metal and slag samples were taken before and after oxygen injection, temperature checks were made when possible, and attempts were made in some instances to estimate the slag bulk by using titania additions to the slag. Apart from differences in technique and furnace design the heats varied in: (*a*) the weight of metal, (*b*) the initial composition of the metal and the slag, (*c*) the temperature at commencement of injection, and (*d*) the rate and volume of oxygen injected.

Interpretation of the data obtained so far involves 31 heats. The efficiency of oxygen utilization was found to vary considerably from heat to heat. In considering the efficiency of the use of oxygen, the content of elements with a high affinity for oxygen of the molten-metal bath must be taken into account. A factor can be calculated which may be termed the "cumulative potential" of the bath, which takes into account both the quantity of reactive elements, such as C, Mn, Si, Cr and their relative affinities for oxygen. It has been found that for a given level of "cumulative potential" the efficiency of oxygen utilization varies inversely with the volume of oxygen used, *i.e.*, the lower the volume of oxygen the higher the efficiency. On the other hand, as the "cumulative potential" increases so does the volume of oxygen required to give 100 per cent. efficiency. The concept of "cumulative potential" combined with measurements of the volume of oxygen injected establishes a criterion of efficiency which enables a study to be made of other factors affecting the process, *e.g.*, rate of blowing.

A chart has been devised which, although at present subject to certain limitations, enables a prediction to be made of the volume of oxygen required to remove any quantity of carbon from any initial carbon level. A similar chart is contemplated which will predict the amount of manganese which would be lost in using the oxygen volume given by the carbon chart.

PLANT ENGINEERING

Moulding-sand Compaction and Moulding Machines

A laboratory study of several methods of determining the degree of compaction of sand has shown that no method is more convenient or accurate than mould-hardness measurements, and this method has been used for assessing the performance of a moulding machine. In addition to the normal flat-surface tests, a modified mould-hardness tester has been designed for measuring the compaction in re-entrant corners.

An investigation was carried out on a simultaneous jolt/squeeze moulding machine, which was made available to the Association by the Osborn Foundry & Engineering Company, Limited. Provisions were made for regulating and measuring the air pressure in the line leading to the machine and among the factors investigated were the following: the effects of squeeze pressure, jolting time, width of pockets, additional weights on top of a mould, the application of pressure with simultaneous jolt, squeeze heads and the condition of moulding sand used.

In order to determine the jolting rate of the machine a simple mechanical device was used, which led to an interesting observation that, when using

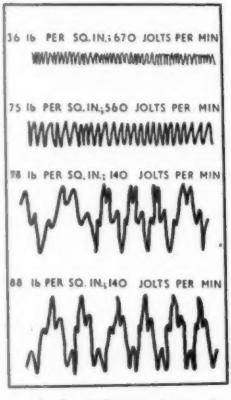

36 lb PER SQ.IN.; 670 JOLTS PER MIN
75 lb PER SQ.IN.; 560 JOLTS PER MIN
78 lb PER SQ.IN.; 140 JOLTS PER MIN
88 lb PER SQ.IN.; 140 JOLTS PER MIN

FIG. 3.—*Traces of the jolt motion of a simultaneous jolt/squeeze moulding machine, showing the change in amplitude and frequency of vibration that occurs when air-line pressure falls below 78 lb. per sq. in.*

jolt, only, a marked change in type of vibration occurred at an air-line pressure of about 78 lb. per sq. in. Below this pressure the jolting frequencies were of the order 550 per minute with an amplitude of about 0.5 in., whilst at higher pressures the jolting frequency fell to 140 per minute but the amplitude increased to about 1.15 in.

Fig. 3 illustrates this change in the vibration characteristics and shows traces obtained with a jolt machine when the air-line pressure was varied between 36 and 88 lb. per sq. in. It will be seen that, as the air pressure increases, the length of the jolt increases but the frequency of the jolt decreases. Also between 75 and 78 lb. per sq. in. the mode of vibration changes from a smooth, uniform wave form to a more complicated wave form in which subsidiary vibrations are superimposed on the principal one.

This investigation has disclosed valuable information correlating mould hardness in pockets and re-entrant corners with squeeze pressure, line pressure during jolting, amplitude and duration of jolting. Further work with other types of moulding machines will include the effect of smoothness of pattern surface and flowability of the sand on the mould hardness and on the surface quality of test castings.

Air-carbon Arc Torch

The Association has arranged demonstrations of the use of the air-carbon arc torch at Bonnington Castings, Limited, and at the Darlington Forge, Limited. Judging by the interest shown and the number of representatives who attended, these demonstrations were successful and it is hoped that they will result in the wider application of this fettling tool.

The evidence from steel foundries using the torch shows that in the removal of excess metal on small castings, the fettling time can be reduced to approximately 50 per cent. of the time required for orthodox procedures, and grindings can be completely eliminated in some cases. In making gouges the saving of time is approximately 70 per cent. when using a torch. This saving in fettling time is accompanied by further economy during subsequent welding, because in most cases cavities made by the torch are smaller than those made when using a pneumatic chisel.

Cavities of the same size were prepared in a scrap casting for demonstration purposes by chipping hammer and Arcair torch respectively. With the former 11 hrs. 37 min. were taken to remove a volume of 81 cub. in. of metal, while with the Arcair torch 87 cub. in. were removed in 4 hrs. 47 min., a time saving of 72 per cent.

Experience in American, and a few British foundries, has confirmed that there is little risk of initiating or propagating cracks attendant upon the use of the torch on low-carbon steel castings, but it is considered that some risk of cracking adjacent to the gouge exists if the torch is used on air-hardening steels. To investigate this point, trial gouges have been made in keel-block castings in a range of alloy steels under a variety of operating conditions. A metallurgical examination of these specimens is in hand at the present time.

INDUSTRIAL HEALTH

Assessment of Atmospheric Dust in Industry

The Association has decided that for long-term sampling of industrial atmospheres the Hexhlet is the most suitable instrument. This is fitted with a horizontal elutriator which removes all coarse particles before collection, so that the sample collected is reasonably representative of the

British Steel Castings Research Association

inhalable dust which may reach the lungs of the workers. By measurement of the mass of sample collected and from the known volume of dust-laden air drawn through the instrument, the dust concentration can be evaluated as weight per standard volume of air (in the BSCRA survey as mg per 100 cub. ft.).

Intensive investigations have been made to establish sampling techniques under foundry conditions. Studies have been made of day-to-day variations in dust concentration, the effect of meteorological conditions on these concentrations and the rate of settling of the airborne dust. The constitution of foundry dusts has also been studied and measurements have been made of the total silica content, the free-quartz content and of other constitutents of the dust samples.

The Association expresses its gratitude to the Safety in Mines Research Establishment for assistance and advice relating to the analysis of dusts.

The report is signed, on behalf of the Council, by Mr. C. H. Kain, the chairman, and Dr. A. H. Sully, the director.

British Standards Institution

Wooden-pattern Equipment for Foundries

British Standards Institution, 2, Park Street, London, W.1, announce the publication of BS. 467:1957 (a revision) covering wooden-pattern equipment for foundries. The 1952 edition of this standard prescribed only a method of colouring and marking wooden patterns used for ferrous and non-ferrous castings; the new edition, published at the request of the National Society of Master Patternmakers, includes the same information and coloured diagram together with a set of provisions dealing generally with the construction of wooden patterns of the following classes: Class I, skeleton patterns; class II, strickle boards; class III, softwood-pattern equipment; class IV, softwood equipment with hardwood reinforcement; class V, hardwood equipment, and class VI, hardwood equipment reinforced with metal.

The standard includes clauses specifying the types and conditions of timber to be used and the construction of wooden-pattern equipment. Other clauses deal with the provision of information by the patternmaker to the foundry. Copies may be obtained from the British Standards Institution, sales branch, 2, Park Street, London, W.1; price 5s.

Japanese Atomic Commission Visit

Mr. Koichi Uda, of the Japanese Atomic-energy Commission, visited Berkeley recently, to inspect the progress made by the A.E.I.-John Thompson Nuclear Energy Company, Limited, in building the 275-mw nuclear-power station for the Central Electricity Authority.

Mr. Uda, who was accompanied by three members of the Japanese House of Representatives and by others from the Atomic Energy Commission, saw the completed excavations for the two reactors, the turbine hall, the work on the concrete foundations and the welding of the first pressure vessel which, when completed, will weigh 1,000 tons. The delegation later visited the headquarters, Radbroke Hall, Cheshire.

Industrial Potential of Titanium

Writing on the "Industrial Potential of Titanium" in the *Battelle Technical Review*, Dr. R. L. Carmichael points out that the price of the metal is steadily being reduced and that within five years titanium sheet, rods, and bars should sell at one-third to one-half of current prices. At such prices the metal, because of its superior properties, will be economic for many uses in the chemical and process industries and in certain consumer products. The price of titanium sponge was $5.00 per lb. through 1954, but has since dropped in stages to below $3.00 per lb. The price of sponge undoubtedly will be further reduced in the future.

In commenting on specific non-military uses for the metal, Dr. Carmichael estimates from 50 to 100 different applications have already been made in prototype products. Examples include the use of the metal in:

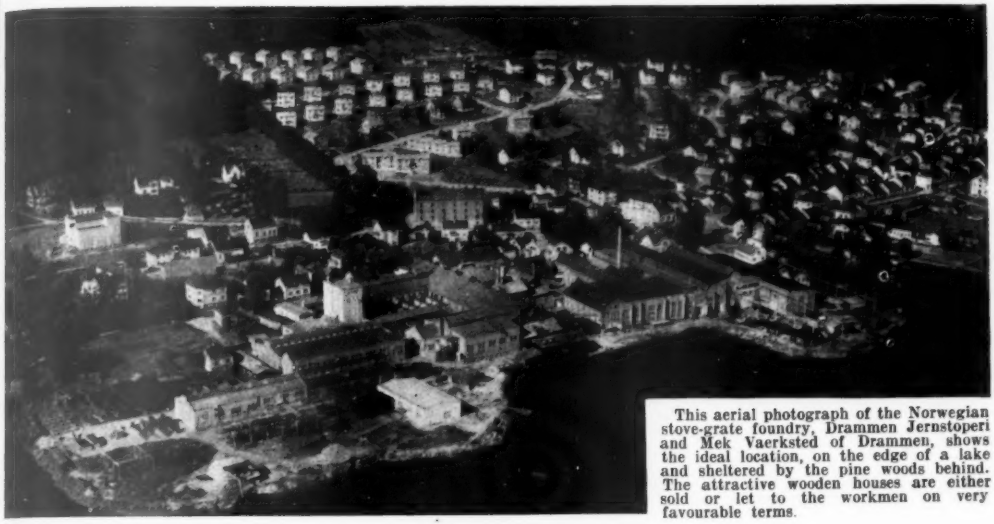
(1) The engine cowling and firewall of commercial planes. (The DC-7 uses about 400 lb. finished weight, the DC-8 will probably use twice as much); (2) impellers, packing-support grids, heat-exchangers, filter presses, condensers, jet diffusers, vessel liners, coils, valves, and agitator covers in the chemical industry; (3) kettles and other equipment for processing acid foods, such as tomatoes, pickles, and sauces; (4) liners for reactors and mixers in pulp and paper processing; (5) clips and racks in aluminium-anodizing shops, agitators, tubing, and valves in metal refining; (6) valves, and trim for marine equipment; (7) anodes, heater bottoms, grid-contact rings, and cathode rings in miniature electronic tubes; wires in rectifiers; and (8) prosthetic devices for orthopædic surgery, hypodermic needles; braces and crutches.

Most applications of the metal have resulted from the desire to take advantage of its good corrosion resistance, its high strength-to-weight ratio, and its good abrasion resistance. Being extremely resistive to many corrosive solvents, it does not contaminate materials coming into contact with it, which is vitally important in certain chemical processes. Shortcomings in using the metal at present are the high cost; poor resistance to certain powerful reducing agents; lack of availability in certain forms; difficulty in welding certain alloys, the problem of galling, which is preventable; and high scrap loss due to the inexperience of fabricators. Most of these shortcomings, the Battelle metals economist states, should be overcome as research continues and as users of titanium gain experience with it.

More Jobs than Unemployed

In June (for the first time since last December), there were fewer unemployed than there were vacancies. The number of unemployed dropped by 49,000 to 265,000 and unfilled vacancies rose by 26,000 to 309,000. The ratio of unemployed to total working population fell from 1.5 per cent. in May to 1.2 per cent. in June, 0.2 per cent. higher than in June, 1956.

In the week ended June 1 there were 1,510,000 workers on overtime in manufacturing, 30,000 more than three months previously, but 30,000 less than a year ago. Those working short-time dropped by 9,000 to 63,000. Those employed in chemicals and allied trades dropped by 1,000 to 529,000. There was no change in metal manufacture (582,000), vehicle manufacture increased by 5,000 to 1,199,000, and engineering, metal goods, and precision instruments dropped by 4,000 to 2,777,000.



This aerial photograph of the Norwegian stove-grate foundry, Drammen Jernstoperi and Mek Vaerksted of Drammen, shows the ideal location, on the edge of a lake and sheltered by the pine woods behind. The attractive wooden houses are either sold or let to the workmen on very favourable terms.

Scandinavian Foundry Review

Special Survey conducted by the Editor

(*Continued from page* 81)

Drammen Jernstoperi

Norwegian Stove-grate Foundry

Whilst the Drammen Jernstoperi and Mek Vaerksted of Drammen operates quite a large mechanized foundry, devoted to the production of stove grates, its business extends to the making of steel castings and large to medium-sized engineering components.

In 1946, it celebrated the centenary of its foundation but it is following an extremely progressive policy, having just installed a German-type hot-blast cupola plant—Geselschaft fur Huttenwerks Anlager—ground is to be cleared for a new foundry shop. The works, which is situated on Drammens Fjord, in surroundings reminiscent of a luxury health resort, is backed by beautiful wooded hills. Here, the company has built attractive wooden houses either for sale, or letting on favourable terms to the workmen. Strategically placed is a play centre for the children. In the works, they have provided well-equipped washing and changing rooms. In place of a canteen (as the men live quite near to the works) a room has been made available for eating meals under pleasant conditions. An efficient fire-fighting service is in being, whereby members of the brigade are called out by an alarm system installed in their houses and is operated by the watchman on duty at the works. A first-aid room, properly equipped, is in charge of a qualified nursing sister, who is supervised by the works doctor.

Transport and Raw Materials

Practically all the raw materials arrive by sea at a nearby dock and reach the works by lorry. Sand for the stove-grate foundry comes from Denmark, containing about 6 per cent. clay and is prepared with bentonite and about 8 per cent. coal dust. The olivine sand is, of course, of Norwegian origin and is used for both the iron jobbing shop and the steelfoundry. The coke comes from Germany and pig-iron from either Holland, Sweden or Germany. As in most of the Scandinavian foundries good use is made of trucks for internal transport.

The whole works employs about 550 people and of these there are about 230 in the foundry of whom 50 are skilled men. No female labour is employed. Average earnings are about £12 per week of 48 hours, but some of the labourers on heavy-duty jobs exceed this wage. In this area there is no shortage of apprentices. In 1945 there was a case of silicosis in the steelfoundry, as a result the management decided to change to olivine instead of a silica-based sand. Mass radiological examination has shown that there is now complete freedom from this malady; in fact, there is an excellent record of longevity amongst the foundry staff.

Stove-grate Foundry

Production from the stove-grate foundry, shown in Fig. 1*a*, is quite different from that in this country, as the firm manufactures a very wide

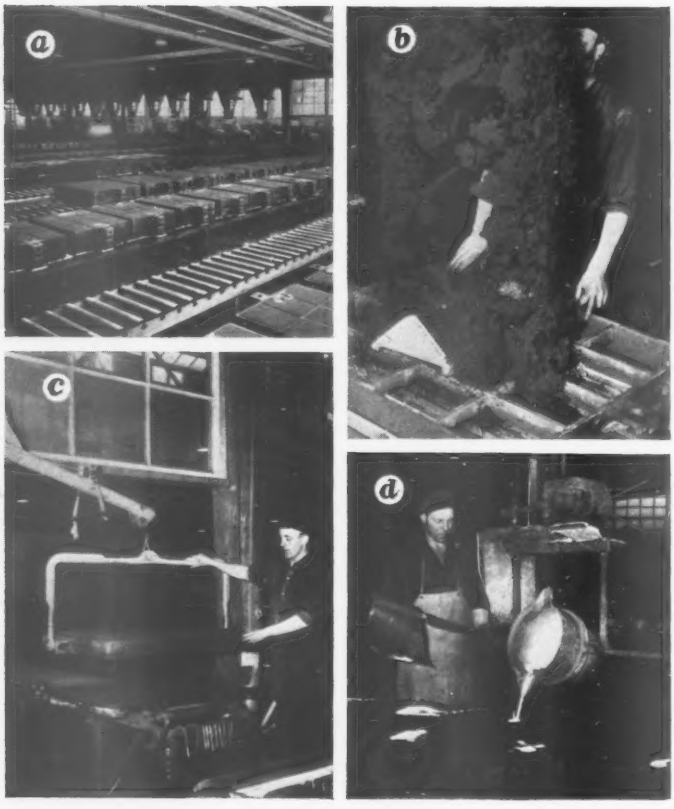


FIG. 1.—*Four views of the stove-gate foundry of Drammen Jernstoperi. (a) General view of the main shop, showing the location of the line of moulding machines, of the Zimmermann type, and the roller-conveyor system; (b) dramatic action picture of sand falling on the gadget, used to reduce mould density of any given area; (c) transferring moulds from one of the machines to the roller-conveyor system, and (d) monorail suspended pouring device in operation; this is of US design, manufactured by Fischer of Switzerland.*

range of wood- or coal-burning, space-heating stoves. Most of them are perhaps not quite as ornate as our Victorian productions, but are still far removed from the stream-lined products being turned out of British foundries. Whilst they would be out of keeping with the décor of a British industrial housing-estate, they will certainly fit into the furnishing of those delightful wooden houses so freely sprinkled amongst the pine forests of Norway.

Equipment

The mechanization of this department has been carried out through the Swedish firm of Westin & Buckland of Stockholm. The general system is based on Zimmermann machines, of which there is a line of 16 situated alongside the wall opposite to the cupola. In front are parallel lines of roller conveyors, each terminating in a knock-out grating over a return-sand conveyor, feeding the sand plant. In front of the machines is a grating through which the spilled sand falls on to a band conveyor. This also takes care of the sand left over after filling; the hoppers, located above each moulding machine, are filled by setting ploughs on the overhead band conveyor. On certain jobs, a gadget consisting of two framed coarse sieves (Fig. 1*b*) constructed to resemble the roof of a house were placed centrally above the pattern-plate, presumably to have a more lightly rammed area in that position.

Another interesting feature of this plant is that the usual type of hoppers with a clam shell closure are each provided with a vibrator. Sticking does not occur frequently, but when it does, the vibrator is brought into action and has apparently provided a solution to a problem not always solved.

The last three or four machines, of larger type than the rest, have a runway and chain clamps for transferring the mould parts to the runway (Fig. 1*c*). Varying with complexity, the mould production per machine will be of the order of 100 to 180 per shift. Pouring is effected by the monorail device, shown in Fig. 1*d*, which is easily operated by one man; the equipment of American design is made by Fischer of Switzerland.

Enamelling Department

The wet process of vitreous enamelling is practised much on the same lines as in Great Britain. The stoves are electrically heated and the frits are imported from either Holland or London, except a black one which is prepared on site. It is apparently a cross between a vitreous and stove enamel which is fired at 800 deg. C., yielding a finish capable of being quite harshly handled without chipping.

Coremaking

All coremaking is carried out in silica sand and an oil obtained from herrings. Recently, however, the CO_2 Process has been installed and cores are being made on a German (Roperwerke) core-

shooter. The drying stoves for the conventional cores are electrically heated using Nichrome elements on the walls.

Steel Foundry

For the jobbing and steel foundries, there is a bucket-loaded, self-emptying speedmuller of Swiss make. The metal for steelmaking, which includes both mild and manganese steel—the latter for crusher jaws—is melted in 1,200-kg Rennerfeld furnace. This furnace, which is shown in Fig. 2*a*, must be about 40 years old but is still giving very good service. Again, stress is laid on the freedom from carbon pick-up. It would appear that this obsolete furnace might warrant examination by the electric-furnace builders. With the usual modern zest for dust extraction, this furnace has been effectively furnished with ducting for this purpose and, moreover, it lends itself very well to this treatment. The current consumption is of the order of 900 to 1,000 kva per ton.

Iron Melting

The new hot-blast cupola, shown in Fig. 2*b*, is of a type which is well known in this country, and is so placed that it will serve the foundry to be constructed in addition to the existing mechanized foundry. The plant consists of two furnaces, each giving 4 tons per hour.

Conclusions

This foundry is of exceptional interest to makers of stove-grate and similar castings, and should be included in the itinerary of such foundrymen who visit this area. Visitors will be cordially received by Mr. Langum, the foundry manager, to whom the writer is greatly indebted for his kind co-operation in the preparation of this description of the foundry and for the many courtesies extended to him, under quite difficult conditions as, at the moment, he is suffering from a compound fracture of his leg due to a ski-ing accident. He hopes to be sufficiently recovered to escort his guests around the works during the post-congress tour.

Norwegian Diesel-engine Foundry

The Foss Jernstoperi (Fig. 3) in Oslo deservedly ranks high amongst European founders of diesel-engine-cylinder castings. This is due to the meticulous control imposed in every stage of their manufacture, together with a test-bed record of their performance.

The firm started in 1875 in a little wooden hut used as a blacksmith's shop. In 1937, much of the present works was erected, which now covers an area of 64,500 sq. ft. About 160 workmen are employed, of whom some 40 are skilled. In the cylinder and general jobbing shops, cement moulding is practised, but in the light semi-repetition sections, olivine sand is used.

Transport

The foundry is situated on the outskirts of Oslo and is served by railway sidings. The stockyards, and indeed all the shops are well served by electric overhead travelling cranes (15 in all) of various capacities and furnished with hooks, magnets or grab buckets. Internally, much use is made of electric battery-type trucks, towing rubber-tyred trailers, each of which will carry up to about seven tons of scrap or pig-iron. In the foundry producing the lighter types of castings, the liquid metal is

FIG. 2.—*Melting facilities for the iron and steel foundries of Drammen Jernstoperi and Mek Vaerksted, are provided by* (*a*) 1,200 *kg. Rennerfeld electric-arc furnace which is about* 40 *years old, and* (*b*) *the new hot-blast cupola of German type—Geselschaft fur Huttenwerks Anlager—situated so as to be able to serve the proposed new foundry shop.*

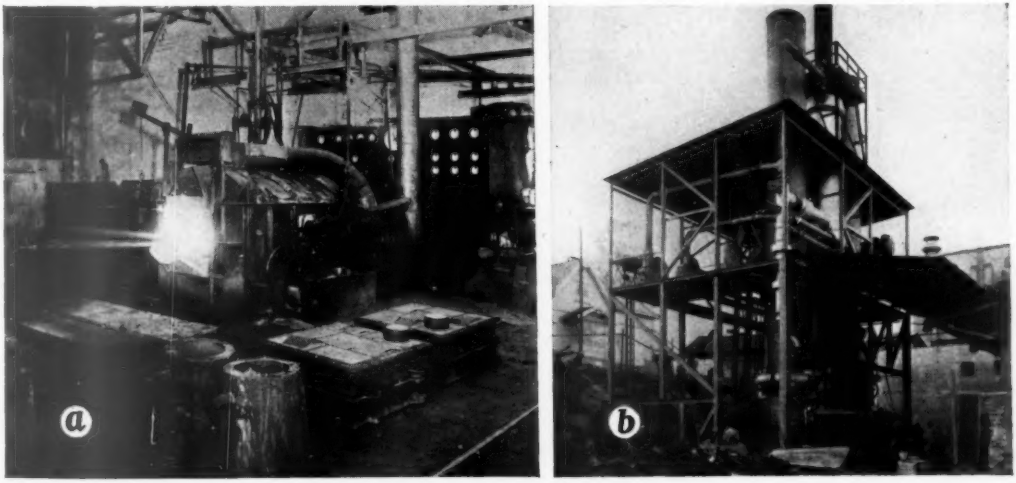


FIG. 3.—*Aerial view of the diesel-engine foundry of Foss; this foundry ranks high amongst European founders of diesel-engine-cylinder castings.*

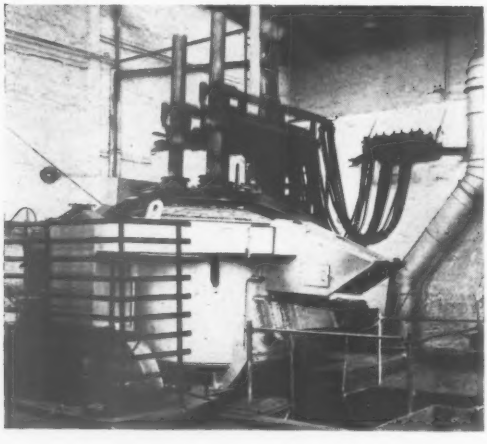
finally transferred to the moulds by Roper, monorail-suspended, one-man-operated ladles.

The jobbing shop has been constructed of prefabricated sections and the result is excellent, for the walls and roof are white and smooth. The shops are generously heated, whilst the ventilation has obviously had great thought expended on it.

Cylinder-liner Production

The metal for cylinder liners, and nearly all the castings, is melted in an 8-ton Heroult electric-arc furnace (Fig. 4), tapping four times each day. It is semi-mechanically charged and this operation takes 20 minutes. It is acid lined and the roof

FIG. 4.—*Most of the metal utilized by Foss Jernstoperi is melted in an 8-ton capacity Heroult electric-arc furnace, which is tapped four times per day.*



"life," using Swedish silica bricks, is excellent. The charge consists of Vantit pig-iron, steel and foundry return scrap. Before casting, samples are sent to the laboratory for analysis, and the results are available in about 20 minutes. Casting temperature is from 1,350 to 1,400 deg. C. and regularly checked. The current consumption ranges between 500 and 550 kva. per ton melted. Between the crane hook and the ladle is a Salter weighing machine and the melter is provided with special glasses for accurately reading the weight when the ladle is suspended above the moulds. Thus, a carefully-weighed amount of metal is admitted into each mould. The humidity within the moulds is also recorded.

The casting station has been centralized and immediately the moulds have been cast, one or both of two ducted canopies are swung over the moulds to remove fumes (Fig. 5). The furnace also is well ventilated for fume removal. A second electric furnace is on order, so that shortly it will be unnecessary to supplement the molten-iron output by cupola metal. At the moment, between 5,000 and 6,000 tons of castings are being produced annually.

A very large stock of moulding boxes is available to cater for the wide range of sizes of liners made. The ladles are all nicely painted with aluminium and are of the Collin type. Great care is exercised in slagging the ladles. A first-class metallurgical control is imposed, which includes much metallographic examination, whilst wherever possible, the case-histories of the liners in service are followed through and correlated with foundry conditions.

Plant and Equipment

Recently, the chemical laboratory at the foundry was burnt down and this work is now temporarily carried on in what is to be the new patternshop. The old patternshop is on the small side but, using a mixture of English and German machines, is turning out first-class patterns and carrying out much repair work. Many of the patterns come from the shops of master patternmakers.

Sand mixing is done in an 8-ft. dia. August-Simpson mill, and a smaller Simpson design by Geo. Fischer of Switzerland. In the coremaking shop, there is a Fordath Mixer. Core drying is done in stoves carrying electric heating elements on their walls and using an air-circulation system: the stoves being provided with a stand-by oil-firing system.

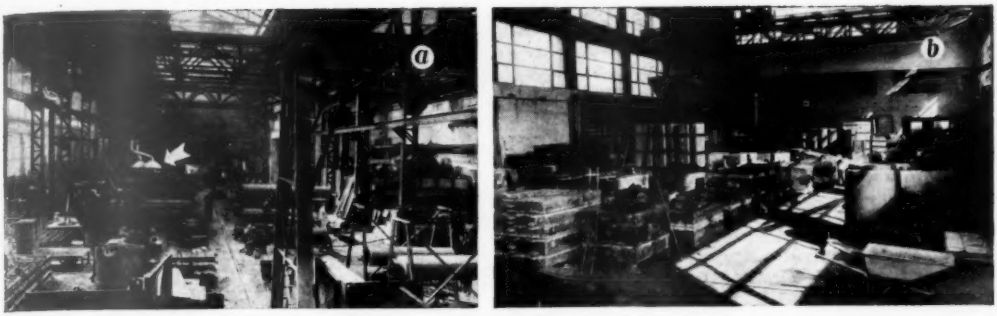


FIG. 5.—*Two views of the mains bays at Foss Jernstoperi: (a) The main casting bay, showing (arrowed) the two fume hoods employed for fume extraction from the casting area, and (b) the main moulding bay.*

Ladles are dried by the use of oil burners. The repetition foundry is served by a number of Bonvillain and Ronceray moulding machines.

Conclusions

Visitors to the Stockholm conference should, if possible include this foundry in their tour, for here they will see an advanced type of foundry practice carried out in as nearly-ideal conditions as will be found anywhere in Europe. Even separate washing, bathing and changing facilities are provided for the foremen.

Finally, the writer thanks Mr. A. Arstal for his co-operation in the preparation of this article and also for the many courtesies extended during his visit.

Bentse Stoperi

Bentse Stoperi is situated at Bentse Brugt, on the outskirts of Oslo, Norway. The foundry is a company associated with two or three engineering concerns making machinery for the hydro-electric, paper pulp and woodworking industries. It presents many features of outstanding interest to readers, in so much as it is a jobbing foundry which in every way, meets the conditions laid down by the Iron and Steel Foundry Regulations. Thus, the casting position is centralized; fettling and knock-out are carried out in shops separate from the main foundry, and a central sand-preparing plant has been installed. This has been made possible because, though the foundry was established in 1849 in the year of its centenary, it was greatly extended by the provision of a new, large foundry building. The old shop then became the moulding department for smaller work.

Transport Facilities

All raw materials arrive by lorry, where the pig-iron (mainly hematite) and a vanadium/titanium-bearing pig-iron (Vanitet) are unloaded by an overhead-travelling crane, provided with a lifting magnet. The sand used is olivine and this is handled by a grab attachment. As the weather can be very cold in Oslo, the monthly supply is kept out of doors but under a roof, a weekly supply is maintained indoors. In the heavy foundry, there are 30- and 15-ton electric overhead-travelling cranes, the former with a 10-ton auxiliary lift. These are supplemented by five 2-ton jib-cranes. Other cranes span the bays of the small-casting section, the fettling shops, and so forth. The sand-preparation plant, which has been supplied by Malcus Holmquist of Sweden, discharges the prepared sand from a swinging launder, to fill rubber-tyred bogies easily transportable to the various moulding stations. A petrol-driven fork-lift truck is also in use for general transport purposes.

Patterns

Whilst the foundry does operate its own pattern-shop, mainly for repairs and alterations, most of the patterns are received from customers or master patternmakers; it was noticed that some of these patterns had not been specially designed for ease of moulding. Most of the patterns were of wood, were well maintained and certainly enabled the firm to produce excellent castings.

General Conditions

The new main bay (Fig. 6*a*) is very lofty and the air entering it is at a pre-determined temperature resulting in comfortable working conditions even in the height of a Scandinavian winter. The 30 skilled men, assisted by about 55 labourers, produce some 1,500 tons of iron castings each year, together with about 100 tons of stainless-alloy castings. Bathrooms, with "clean" and "dirty" clothes lockers have been furnished. The firm also has a canteen which needs subsidizing by the management. It was noticed, however, that some preferred to eat the luncheon "on the job," in the works. Situated within the works, and operated in conjunction with associated companies, is a well appointed apprentice school. The men work a 48-hour week but this is to be reduced to 45 hrs. in 1960 (these figures do not agree with some recently published by the Board of Trade).

Moulding

The moulding plant employs olivine sand exclusively, this, even in Norway, is not cheap but

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it certainly results in an excellent surface finish; the sand is mixed with about 10 per cent. coal dust, some 10 per cent. of the used sand being discarded each week. Curiously enough, at the time of this visit, the runner basins were being made up of cement sand. Cores are made up with conventional silica sand and bonded with a locally-manufactured linseed-oil base.

The main moulding unit is a motive Sandslinger (Fig. 6*b*), supplied by Foundry Plant & Machinery, Limited. This plant has given every satisfaction, maintenance costs being at a minimum. Strategically located around the shops, with concrete floor, with large pits for strickling up of calendar rolls and similar castings, are three Badische jolt/squeeze moulding machines of 5-ton, 3½-ton and 2-ton capacity, the last of which is also a turnover machine.

The largest mould-stove (Fig. 6*c*), which is about 16 ft. wide by 16 ft. long and 10 ft. high, is oil-fired and furnished with a heat-circulation system. Smaller stoves for moulds and cores are available and are similarly oil-fired.

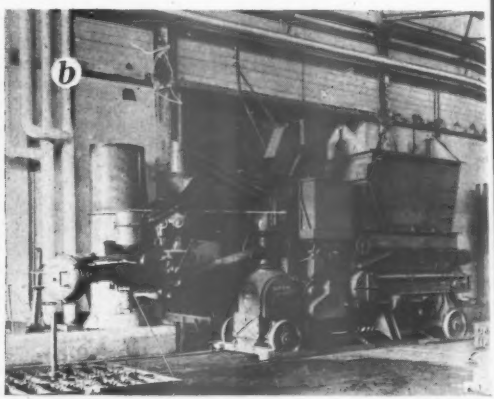
As knocking-out is centralized in a shop, which is a continuation of the large moulding bay, the sand is returned by conveyor beneath the shop to the sand-preparing plant at the other side of the bay.

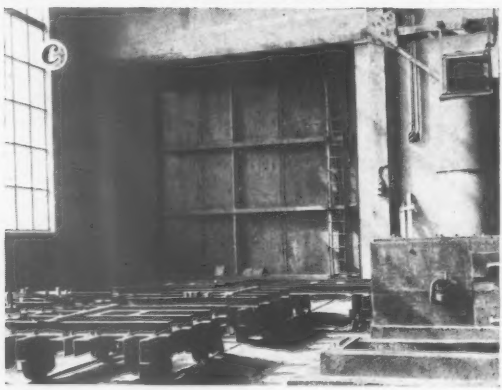
Melting Facilities

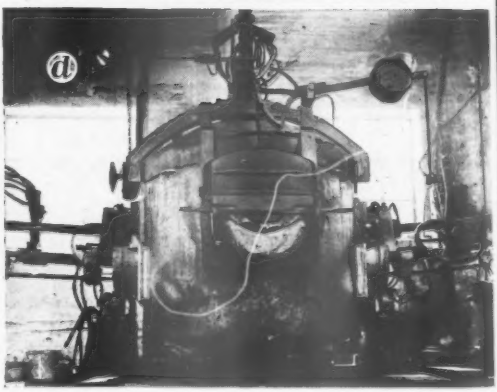
For a long time, melting was carried out in a battery of three 8-ton per hr. mechanically-charged cupolas of the Meehanite design, however, only one is left in operation and in the future, reliance is being placed upon electric melting*. A 10-ton Héroult furnace has been in operation for the last

* Probably due to the comparatively low cost of hydro-electric power.—EDITOR.

FIG. 6.—*Four views of the foundry departments and plant in use at the foundries of Bentse Stoperi at Oslo, in Norway:* (*a*) *New main-bay, in which both pit and floor moulding is effected;* (*b*) *a motive Sandslinger by Foundry Plant and Machinery, Limited, is employed for the majority of the moulding work, and is fitted with a* 20*-ft. arm;* (*c*) *the largest mould-stove at the Bentse foundries measures* 16 *by* 16 *by* 10*-ft. high, and is oil-fired, and* (*d*) *the company's special stainless steel is melted in a very old, but efficient Rennerfeld furnace of* 21*-cwt. capacity.*







three months; this is hand charged, but furnished with a Swedish system of automatic electrode-regulation. For melting a special stainless-steel, there is a very old, but still efficient, Rennerfeld furnace (Fig. 6*d*); owing to the arrangement of the electrode system, in this type of furnace, which is no longer on the market, there is no carbon pick-up. The furnace is of 21-cwt. capacity which caters for the range of size of castings generally called for. It is of interest to note that the ladle is transferred to a closeable cubby-hole, where the metal is treated with magnesium. This creates much fume and it is typical of this firm's practice to remove all dust and fume from the moulding shops as, at least in winter, ventilation and heating are both difficult and expensive. The third melting plant, used for special alloys, is a Birlec-Detroit rocking-arc furnace.

Casting and Knocking-out

All transportable moulds are taken to a central area for casting, adjacent to which are a number of cast-iron pig moulds for over metal. As stainless-steel castings are moulded in exactly the same olivine sand as the iron ones, they, together with their runners and risers, are marked with red paint at the knock-out. For this purpose, an American machine has been chosen. It is of the type with the exhaust applied at the back and curving over somewhat towards its top.

Fettling

Unless memory be deficient, the Hydroblast plant installed here was the largest the writer has so far encountered; it is true to say, judging by the cleaned castings, it was extremely efficient, owing to the fact that it operates on olivine sand, comparison with British practice is difficult. The smaller castings are put through a Gutmann rotary-table machine.

A visit was also paid to a foundry belonging to an associated company, where the quality of the castings well merited the appelation of "excellent."

The writer expresses his thanks to Mr. Smestad, the director of the foundry, for the many courtesies extended to him during his visit to Oslo and especially for the help given in the preparation of this article.

Founding/Cement-making Analogy

Believing in the dictum that there is always something to be gained from a works visit, even when not to a foundry, the writer was prompted to make mental analogy between founding and cement-making during the course of a visit to the works of the Lafarge Aluminous Cement Company, Limited, at West Thurrock, Essex. This was because the cement works uses not dissimilar processes to founders and yet appeared to be much more advanced towards automatic working than any foundry he knows. Thus, it was thought foundrymen might glean some useful points from the following:

To begin with, cement making is a hot process—one of the party made the remark on leaving the vicinity of the cement furnace: "How cool it seems in this scorching sunshine"! (The thermometer was then registering over 80 in the shade!). Nevertheless, few men if any are employed near cement furnaces, all is done by pressing buttons in a cubicle. The works personnel-requirement, besides the button-pressers and maintenance men (behind the scenes) would seem to be but half-a-dozen or so labourers.

Here, then, were raw-material bunkers (for lime, bauxite, etc.) not unlike foundry bunkers, having their contents—untouched by hand—discharged into a batch hopper for charging the furnace. This was done by selectively operating vibratory feed-belts at the mouths of the hoppers for predetermined times. The furnace was a cross between cupola and open-hearth and tapped continuously. The batches of raw material were fed into the top of the shaft portion through a sealing device rather like a blast-furnace bell. Then the material fell into one end of the hearth where it was melted by a pulverized-coal flame injected from the other. The resulting molten mass was ejected at one side through a continuous tapping box into shallow cast-steel moulds, for all the world like continuously-cast pig. Travelling on this mould machine, the cakes of cement clinker, when cool enough, were first broken up by hammers (released automatically by cam action from above) and then discharged into waiting pendulum baskets; later the material was taken to huge rotary ball-crushers, arranged horizontally. Another neat feature of the plant was the way in which process reject material was automatically shunted back to take an earlier place again in the flow-production scheme—this also applied to the dust collected at various points.

In the mental analogy, the following ideas for foundrymen were thus presented as perhaps desirable, if not immediately practical:—(*a*) elimination of men working on "hot" sites or close to furnaces, by utilizing push-button-controlled furnace-operation and ladle-filling (it is the mechanisms "linking" already mechanized operations which now need development in foundries); (*b*) the design of a combined shaft-and-hearth furnace (the newer types of oil-fired furnaces would seem to enter this category); (*c*) furnace charge-preparation completely effected by remote control; (*d*) similar methods to those for charge preparation applied to sand milling and mixing; (*e*) knocking-out and git-cutting arranged without manual attendance; and (*f*) automatic return of process scrap. Of course, in many foundry establishments these sort of things are being actively pursued and in others, they may yet be quite impracticable. Nevertheless, an instinct to seize on what ideas a kindred industry has to offer is surely quite important.

Flow Diagrams of Plant

In closing this brief account, the method used for showing this somewhat noisy cement works to visitors is well worth mention. At convenient stages along the line of the tour—which logically followed the process from raw material to packing—were hung framed and glazed flow-diagrams (some six in all) of the part of the plant about to be inspected. These made the guide's job easier, because, instead of shouting above the din of the machinery, all he need do was point out the next sequence of events on the appropriate picture as he reached it. The pictures were also much appreciated by the guests, because the basic scheme underlying the confusion of strange plant was immediately apparent. It seems that the framed pictures are put up each time visitors are expected—a device which foundrymen hosts might consider profitable to emulate on the next works-visit day.

Equipment & Supplies

Holding and Melting Furnaces for Die-casting Alloys

In the recent report* on conditions in non-ferrous foundries, stress was laid on the uncomfortable conditions obtaining in die-casting shops, which resulted from emission of heat from the holding furnaces distributed throughout the shop, especially during the summer months. Where covers have been furnished for such furnaces in the past, they were of a type which hindered production and soon fell out of use. Whilst the report put forward one solution for the trouble, modern progress is such that already a second is available. This is the Birlec-Morgan electric die-casting furnace (EDF MkI) shown in Fig. 1 (left). It is the result of close technical collaboration between the Morgan Crucible Company, Limited, Battersea Church Road, London, S.W.11, and Birlec, Limited, of Birmingham. This furnace eliminates the heat-emission nuisance by the imposition of an insulated cover for the metal bath, which slides out of position as a result of foot pressure by the operator on a semi-circular ring hinged to the base of the furnace body. On the release of this pressure, the cover returns to its original position. The furnace shown has an (aluminium) capacity of 300 lb. and is suitable for connecting up with a 3-phase, 50-cycle electricity supply, with voltages ranging between 380 and 400. Heating is effected through a coil of nickel-chrome wire set in specially shaped moulded refractory bricks. Surrounding this layer are two rings of refractory insulating bricks and these in turn are surrounded by a layer of insulated slabs.

Control Features

The furnace is rated at 25 kw, and the temperature is automatically controllable, as desired, up to a maximum of 800 deg. C. This automatic on-off-control is based on a constantly immersed thermocouple, enclosed by a mullite/silicon-carbide sheath. Protection is afforded against the heating elements reaching too high a temperature and as a result of this and the general design the "life" of the elements is estimated at 1½ to 2 years. A useful ancillary to the furnace is a time-switch, through the activation of which, the furnace can be arranged to be at a suitable temperature for operation at the beginning of a shift. For maintaining the bath of the 300-lb. furnace at 720 deg. C.± 5 deg. the power consumption is of the order of 9 kw per hour.

Whilst low figures (15 deg. C.) for the temperature variations are shown, when taking out 10 lb. of liquid metal from the EDF MkI furnace,† and adding a similar quantity of cold metal at eight minute intervals, it is preferable to add liquid metal from time to time. For providing this molten metal a new (BT MkII) of basin-type tilting crucible furnace has been designed and installed in Morgan's experimental foundry. As is shown in Fig. 1 (right), it is oil-fired, having an aluminium capacity of 380 lb.; its shape certainly facilitates charging and its modern design makes for economy in operation.

* "First Report of the Joint Standing Committee on Safety, Health, and Welfare Conditions in Non-ferrous Foundries" (HM Stationery Office, price 7s. 6d. net).

† This furnace is to be shown at the forthcoming Engineering, Marine, Welding and Nuclear Energy Exhibition, on the Electrical Development Association's stand.

New Dust Respirator

Weighing only 3 oz., the "Dustfoe 66" dust mask is now being manufactured by Mine Safety Appliances, Limited, on the Queenslie Industrial Estate, Glasgow.

One of the main features of the mask is a new face-piece cushion which is contoured to provide a comfortable fit. The cushion is made of neoprene sponge, which has good wearing qualities and does not harden during use. More sponge stock has been added to ensure that the cushion provides an airtight seal. The respirator has newly-designed exhalation valves, which are larger than on previous models. Breathing resistance has been reduced to a minimum by the new valves. Static-web preformed filters are fitted and are treated with an electrostatically-charged resin which improves the filtering efficiency and supplements the mechanical action of the filter fibres. No pre-filters are required. The filter holder is of new, narrow design which increases downward vision, minimizing the "blind spot."

FIG. 1 (*left*).—*Birlec-Morgan electric holding-furnace for die-casting alloys of 300-lb. capacity; the operator can be seen depressing the semi-circular ring which opens the insulated cover; electrical control-gear is situated behind the furnace.* (*Right*) *Morgan basin-tilting, oil-fired crucible furnace of 380-lb. capacity, showing the arrangement of charging platform and associated equipment.*

European Foundry Apprentice Competition

Detailed Arrangements for Annual Event

As already briefly announced in this JOURNAL, the European Committee of Foundry Associations (not to be confused with the International Committee of Foundry Technical Associations) is organizing an annual competition—mainly on a practical basis—open to foundry apprentices in the countries represented on the Committee. It is expected that all the UK metal-founding associations will co-operate in the arrangements and in this respect, the Council of Ironfoundry Associations have prepared a translation of the rules put forward by the German foundry association to govern the contests and, in particular, that to be held next year; extracts from these are reproduced below. The Institute of British Foundrymen has agreed to assist in securing entrants from the UK for the competition and adjudicating on these to reduce the number of applicants, first, to not more than 12. Apprentices who would like to be considered for entry into the first competition (1958) are therefore advised to signify this to the secretary of the Institute or honorary secretaries of local branches not later than August 31. It should be emphasized that prospective entry is open to all apprentices fulfilling the conditions and not confined to members of the Institute. Those from this country actually put forward for taking part in the competition will finally be restricted to three. The winner will be designated the best apprentice moulder/coremaker of the year.

General Particulars

The following general particulars apply to the competition scheme (not only to that being held in 1958).

Date and Place of Enrolment:

In November of each year, enrolment will take place. The competition will be held in each country in succession, provided candidates from that country are presented: in Germany for the year 1957; in France for 1958; in Italy for 1959; in Holland for 1960, etc. For participation in the competition, the candidate shall (1) be not more than 19 years of age in the year of the competition. (2) have been an apprentice moulder/coremaker in the foundry, or a pupil in a public or private school of apprentices. (3) have obtained a certificate of completion of apprenticeship during the year of the competition.*

Representation of Countries and Determination of Number of Candidates.

Each country is entitled to present a maximum of three candidates, and that country's association shall inform the president of the Examining Board, *normally by June 15 at the latest*, of the number of candidates which it undertakes to present, in order to enable the organizing country to prepare the requisite number of patterns. The record file of each candidate must include a certified or photostat copy of the diploma or certificate or completion of apprenticeship issued to the said candidate.* The files of the candidate being presented shall be addressed to the president of the Examining Board, *at the latest by the end of October*, to permit time for scrutiny of the qualifications submitted.

Practical Workshop Test

Each candidate will be issued, for the purpose of the practical test, with an identical pattern, coreboxes and other necessary gear. The candidate shall provide his own personal set of moulder's small tools. (*a*) The practical test being decided a sufficient time in advance (about 6 months before the date of the competition), the preparation of the patterns shall be left each year to the country organizing the test. (*b*) It has further been decided that moulding shall be performed in boxes not exceeding 23½-in. square (600 mm. square). (*c*) The design of the pattern shall be such as to permit of a mould to be made for casting in any of the following metals: steel, cast-iron, light alloys, or copper-base alloys.

Proposal and Presentation of Subjects for Tests

Each country shall, *at the latest by March 15*, submit to the president of the Examining Board, confidentially, its proposals in regard to subjects for tests, which must be drawn up in the language of the country of the president of the Examining Board and, in addition, either in the German or the French language. Each country shall submit not less than two suggestions for each test, *viz.*: practical test; technology; drawing; calculation, and essay on general knowledge and composition. Typical answers (likewise in two languages) shall be submitted with the suggestions for the following tests: technology; drawing, and calculation.

In the "*Practical test*," each suggestion shall include: (*a*) The working drawings of the castings to be made, and of the patterns and coreboxes to be provided, in addition to all information with reference to the design of the set castings, (*b*) (if possible) photographs of the set castings, and (*c*) the task set should admit of the casting being completed in eight hours, approximately, by a trained craftsman, in the same conditions as contemplated for the test.

As to "*Technology*," each suggestion for this examination shall include: (*a*) five questions in general technology, and (*b*) four questions, each referring to the execution of one of the following casting techniques: steel, cast-iron, light alloys or copper-base alloys.

In "*Drawing*," each suggestion shall take into account the following conditions: The candidate shall execute free-hand (rule and dividers may be used) a dimensioned sketch from a set casting shown or from a production drawing on which the work to be done is specified. The drawings submitted may be of either of the following sizes: (420 by 297 mm. or 210 by 297 mm.) (16½ by 11¾ in. or 8¼ by 11¾ in.)

For the "*Calculation*," each suggestion shall incorporate: one problem, embodying five questions of increasing difficulty, referring to calculations required in the practice of foundry work.

For the "Essay on General Knowledge and Composition," the subjects suggested should refer to the exercise

* Eligibility of UK candidates: The rule requiring that candidates should be in possession of a certificate of completion of apprenticeship has been waived in respect of United Kingdom candidates. To be eligible, these candidates must be not more than 19 years of age in the year of the competition and be serving an apprenticeship as moulder/coremaker.

European Foundry Apprentice Competition

of the craft, the advances made in the trade, the characteristics and qualifications of personnel working in foundries, future prospects, European co-operation, etc.

Choice of Subjects

All the subjects submitted shall be examined by a small committee, restricted to three or four teachers and engineers (one of whom shall be the president of the Examining Board). The president shall, by drawing lots in the presence of representatives of the participating countries, make the definitive choice of the subjects for each test.

Examining Board

Each country presenting candidates shall delegate to the place or places at which the competition is held one or more qualified representatives, for marking the different tests. Each of the member countries of the European Committee of Foundry Associations shall have the right to delegate observers to the tests and the activities of the examining board.

Awards and Certificates

(*a*) *Individual Awards*: A work of art shall be awarded to each of the candidates, but the first three, if there are no fewer than ten candidates, or the first five, if there are more than 15 candidates, shall receive one of greater value.

(*b*) *Awards to Countries*: The country having the team receiving the greatest number of points shall be awarded a trophy. Only countries presenting at least three candidates shall be eligible for this award. The trophy will be presented by the president of the European Committee of Foundry Associations.

(*c*) *Certificates*: A certificate of participation shall be issued to each candidate.

Organizing Expenses

(*a*) The following expenses shall be borne by the country in which the tests take place: Organization of the tests; preparation of the patterns; entertainment and closing ceremonies, and individual awards to prize-winners.

(*b*) Expenses to be borne individually by the participating countries are: Travelling and living expenses of representatives on the examining board and travelling and living expenses of candidates.

(*c*) The cost of acquisition of the trophy (about 50,000 French francs) shall be borne by the European Committee of Foundry Associations. This trophy shall each year remain the property of the country graded first. It will be selected by the country in which the competition is held.

(*d*) Each of the participating countries shall take out insurance in respect of its representatives on the examining board and its candidates.

Additional Information

Further information has been communicated to the organizers in each country concerning the following:

(1) Details concerning the conduct and marking of the tests: (*a*) for the practical tests; (*b*) for the technology; (*c*) for drawing; (*d*) for the calculation, and (*e*) for the essay on general knowledge and composition (this last only to be used in the case of a "tie"). The greatest emphasis is being laid on the practical tests. In each case information is given as to the way in which the tests will be organized and the marking system employed. In the practical test, marks will be awarded according to the time expended on coremaking, moulding and assembling the mould and also for coremaking and moulding, points will be allocated for skill and workmanship. The marking will take no account of the parting direction selected by the candidate, nor of the general arrangement of the gating. Other points which will be assessed, however, are "Mould Assembly"; "Mould Design"; "Appearance," and "Value of the Work."

Phenolic-resins Research

The Shallway International Corporation, 1450 University Avenue, Palo Alto, California and Crawley, England, has just completed a market research into the rates of consumption of phenolic resins used in shell mould and shell-core production, and has made available the figures shown in Table I.

TABLE I.—*Estimated Current Consumption Rates of Phenolic Resins in Shell Mould and Shell-core Production.*

Country.	Estimated number of foundries.	Estimated number of foundries using shell moulding on production basis.	Estimated monthly consumption of phenolic resin for shell moulding.
			(permissible tons per month).
United States ..	6,070	520	700
Japan	2,100	325	250
England	4,200	350	230
France	3,000	65	80
Germany	3,000	60	80
Canada	580	95	65
South Africa ..	500	25	30
Belgium	400	20	25
Italy	1,000	14	20
Netherlands ..	360	12	18
Other European countries	600	50	50
Other countries of Asia, Middle East, Africa, Australasia and Latin America	3,000	55	60

Fume Problem Not Yet Solved

"The Smethwick firm of Dartmouth Auto Castings, Limited, is prepared to spend up to £20,000 on a foolproof system of cutting out dust and fume pollution," said Councillor Richard Pritchard, chairman of the health committee, at a recent meeting of the Smethwick Town Council. He added that world experts had not been able to make headway on the problem, and consequently the residents would have to suffer for a little while yet; they should know, however, that every effort was being made to find a cure. He was replying to complaints from councillors representing the area near the works of the company.

Councillor J. J. Randle who said he had been raising the matter for three or four years and thought it was time that something was done about it, received the reply that the company was prepared to instal dust- and fume-extraction plant as soon as experts could guarantee an efficient installation. It was a big problem which could not be easily solved, and the firm would want a complete solution for such a large sum of money. Councillor Pritchard added that he was convinced that "the brains of this country could work out a cure."

Arc-furnace Studies*

The combined cost of electricity and electrodes is between one-third and one-half of the total cost of electric steelmaking in the UK. For this reason, electricity consumption and electrode wear have been examined by the steelmaking division of British Iron and Steel Research Association, using a 10-cwt. experimental furnace in their laboratory at Sheffield. Roof wear was also studied and heat-balances for the furnace were made under different conditions, and what follows is a report of the results to date.

Development work at BISRA has been concentrated mainly on the melting period of the steelmaking operation, which has been somewhat neglected in previous studies on these furnaces, most of which have been primarily concerned with the refining state. The experimental furnace at the Sheffield laboratories is of conventional Héroult design (Fig. 1), but incorporates several special features which allow much greater changes to be made in operating conditions than is possible with most production furnaces. For example, the height of the roof and the size of the pitch-circle of the electrodes can be altered. During 180 heats the power input, type of scrap, weight of the charge, height of the furnace food, and the electrode diameter were systematically varied.

Electricity Consumption

One of the objects of the investigation was to obtain a measure of the effects of power-input on electricity consumption and melting-time. The results obtained are shown in Fig. 2. Melting with a power-input of 500 kw. took less than half as long as with 250 kw. input, and this reduced the heat losses to such an extent that 16 per cent. less electricity was used. It is estimated that the possible savings in electricity consumed by 10 or 20-ton furnaces would be about 60 per cent. of those made with the 10-cwt. furnace, since the heat losses from a larger furnace represent a smaller proportion of the total heat-input.

With existing production furnaces, the economics of using transformers to their maximum capacities depend on balancing the value of a high production rate and the reduced electricity consumption against increased maximum-demand charges. Production may often be the over-riding consideration.

In a recent works test, the power-input to a 3-ton arc furnace was varied between 1,100 and 2,000 kw.; the electricity consumption at the highest input was about six per cent. below that for the lowest, and the melting time was reduced by about half.

Electrode Consumption

With the 10-cwt. furnace, wide variations in power input had little effect on the electrode-consumption per ton of steel; it is possible that the same will be true of a production furnace if the current-density is not excessively high. The safe maximum is probably greater than the highest current density normally used in practice; in the trials on the 10-cwt. furnace, the electrode consumption per ton of steel, when 7-in. dia. electrodes were used, was nearly twice that for the normal 4-in. electrodes. Electrode consumption was, in fact, closely proportional to the surface area of the part of the electrode exposed in the furnace. Similarly, when the height of the roof was varied, consumption was proportional to the length of electrode inside the furnace. It was found that only about 40 per cent. of the electrode wear occurred at the arcing end, the remainder occurred at the sides, and was directly due to oxidation. The distribution of wear found in one test is shown in Fig. 3. In production furnaces between 40 and 60 per cent. of the total wear probably occurs at the arcing end.

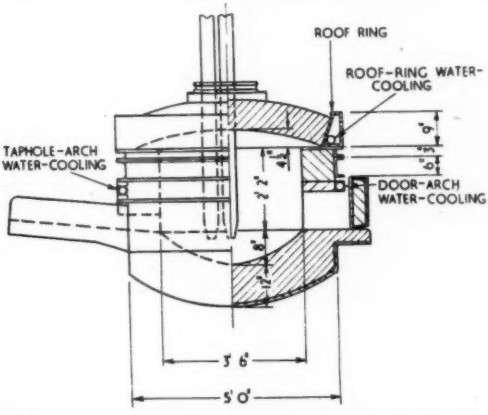


FIG. 1.—*Cross-section, and principal dimensions of the BISRA 10-cwt. arc furnace.*

The results of the trials indicate that, for example, the consumption of 14-in. electrodes would be about 15 per cent. greater than of electrodes of 12 in. dia., provided that the 12-in. electrodes were strong enough not to be broken easily in use. The type of scrap melted in the furnace is an important factor.

Roof Wear

The rate of wear of the firebrick-roofs used in the trials was found to depend to a great extent on operating conditions, and was closely related to the maximum temperature reached by the inside-surface of the roof. A similar trend was found in

* Abstracted from information made available by the British Iron and Steel Research Association.

Arc furnace Studies

a few tests made with silica-roofs. The most important single factor affecting roof wear in the 10-cwt. furnace was found to be the height of the roof itself. With the roof in the "high" position, the wear was about a quarter as much as in a position 9 in. lower The present trend towards adopting higher roofs in order to reduce back-charging can be expected to result in lower consumption of roof-refractories, although if the refining period is long the difference will not be as great as that quoted above.

A high power-input during melting was found to increase roof wear, but this increase can be prevented if precautions are taken to reduce the power before the roof temperature becomes too high. To make this practicable, continuous roof temperature-measurement is needed; trials are in progress to improve the techniques for effecting this. Heat balances carried out on the furnace gave useful information on heat losses and suggested a modification to the brickwork to reduce losses to the cooling water.

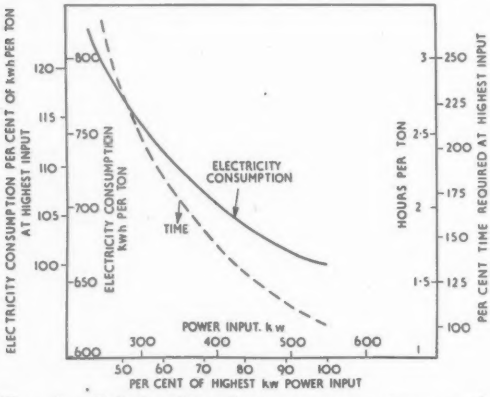

ELECTRICITY CONSUMPTION PER CENT OF kwh PER TON AT HIGHEST INPUT
ELECTRICITY CONSUMPTION kwh PER TON
HOURS PER TON
PER CENT TIME REQUIRED AT HIGHEST INPUT
ELECTRICITY CONSUMPTION
TIME
POWER INPUT. k w
PER CENT OF HIGHEST kw POWER INPUT

FIG. 2.—*Relationships between power input and electricity consumption in melting, and the melting time for the* 10-*cwt. furnace.*

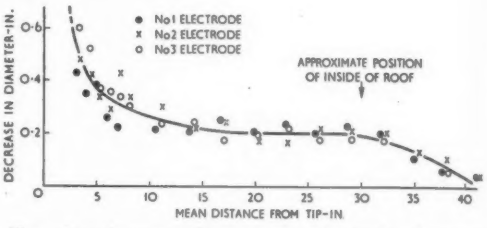


FIG. 3.—*Average decrease in electrode diameter, during two heats of* 5 *hr.* 20 *min. duration, of the three electrodes.*

Book Review

Magnesium Casting Technology, by A. W. Brace and F. A. Allen. Published by Chapman & Hall, Limited, 37, Essex Street, London, W.C.2; price 21s. net.

So far as the reviewer can recall, this is the first book of English origin to be written on the subject of magnesium foundry practice and as such, it is sure of a warm welcome by the industry. Initially, magnesium was suspect because of its inflammability and the man in the street only knew it in the form of powder or ribbon as used by photographers. On a recent visit to a magnesium concern, the managing director related the difficulty he had had to ignite swarf for testing the efficiency of a fire extinguisher. As a metal for casting, magnesium alloys are not too difficult to work with, especially for commercial applications. When making aircraft alloys, however, the situation is more complex and chapter 2 reveals that much alloying is practised, often with quite rare elements. The literature of the subject is quite rich in this field. Chapter 3 covers magnesium-alloy melting practice and herein are disclosed all the various fluxes employed, usually based on the chlorides of magnesium and potassium. The subject of what moulding and core sands to use for magnesium is considered in chapter 4. The moulding mixtures employed and the low casting temperatures and specific gravity constitute the major reasons for special treatment in the foundry. Thus, ordinary oil-sand cores may not always break down after casting due to there being insufficient heat and both moulding and core sands must carry an inhibitor. However, all these difficulties are dealt with, and suitable mixes are detailed. The shell moulding and investment casting processes applied to magnesium are also discussed.

Chapter 5 takes the subject to the production of sand castings and here, well illustrated by photographs and line drawings, many methods are shown for overcoming the inherent properties to be associated with such a lightweight alloy. Trimming and dressing also receives consideration in this chapter and information is given as to suitable plant and tools to minimize the fire hazard. There is a description of the age-old "burning-on" process as applied to this, the newest of the important casting alloys.

The chapters on gravity- and pressure-die-casting (Nos. 6 and 7) are particularly enlightening and the information disclosed will certainly interest those familiar with standard practice, but who are ignorant of the special applications of this metal. The die-coats, materials for dies, furnaces and ladles, are dealt with objectively. Even when it comes to heat-treatment (chapter 8), magnesium has to receive special consideration and a sulphur-dioxide atmosphere used in the furnaces; the castings have to be dust free, and so on. Final chapters cover inspection, surface treatment and applications. This last one, strangely enough, makes no reference to the use of the alloy for corrosion prevention in connection with pipelines and tankers, but does refer to applications where the metal is in competition with wood, as is the case with bricklayers' hods. The book can be wholeheartedly recommended to the general foundryman desiring to have a basic knowledge of magnesium foundry practice, and no doubt even the specialist will find the information he requires set out in logical sequence.

V. C. F.

GRIFFIN & GEORGE, LIMITED, were awarded the contract for laboratory furniture in the new Chance-Pilkington Optical and Ophthalmic Glass Works, at St. Asaph, Flintshire.

News in Brief

THE brassfounding and engineering business of Geo. Taylor & Company, South Park Road, Hamilton, has been sold to George Taylor & Company (Hamilton), Limited.

THE FAMOUS BATH ABBEY BELLS with the carillon have now been returned from repair at a Loughborough bell foundry and will be re-dedicated at a special service on August 3.

H. BROADBENT & SON, LIMITED, Park Street, Ashton-under-Lyne, propose to erect a new foundry and engineering works on a site at Cavendish Street, Ashton-under-Lyne.

A CONTRACT for 30 bogie goods guards' vans has been awarded to the Gloucester Railway Carriage & Wagon Company, Limited, by Rhodesia Railways. This follows a recent order for 88 passenger coaches.

AN AGREEMENT has been signed by the Export-Import Bank of Washington and the Sociedad Mixta Siderurgia Argentina to extend the credit until the end of 1960 of US$60,000,000 granted to build the General Savio steel plant.

TWO DREDGERS are to be built by Lobnitz & Company, Limited, Renfrew. One is for the British Transport Commission—a suction hopper dredger for service at Hartlepool—and the other for the Director General of Harbours in Norway.

BRITISH INSTITUTE OF MANAGEMENT announce that a National Management Conference is to be held in Bournemouth from November 6 to 8. Details are available from the conference office of the Institute, at 80, Fetter Lane, London, E.C.4.

INDIAN IRON-ORE PRODUCTION during the first quarter of this year was 1,305,000 tons, compared with 1,302,000 tons in the previous quarter. Stocks of iron ore in January were 1,625,000 tons, an increase of 300,000 tons over the stocks at the beginning of last year.

A NEW THREE-STOREY WAREHOUSE and office block has been opened by the Glacier Metal Company, Limited, opposite their main London factory at Alperton. The new building, which houses the main stores and administrative offices of the Replacement Bearing Unit, occupies over 20,000 sq. ft.

PIG-LEAD (minimum content 99.95 per cent.) production in OEEC producer countries—Austria, Belgium, Denmark, France, Germany, Greece, Italy, the Netherlands, the UK, and Sweden—as well as in Morocco and Tunisia, amounted to 51,064 metric tons in May, as compared with 47,871 tons in April.

EDGAR ALLEN & COMPANY, LIMITED, in conjunction with their agents in Finland, O/Y Teraskonttori, Kalevankatu 2, Helsinki K., are exhibiting at the British Trade Fair and Exhibition, Helsinki, from September 6 to 22, a range of engineers' tools, permanent magnets, die steels, special tool steels, etc.

A CONFERENCE on the surface treatment of aluminium is to be held from September 30 to October 1, in Milan. It is being organized under the *aegis* of the *Associazione Italiana di Metallurgia*, 16 Via Moscova, Milan, of which body, Dr. Guido Calbiani, the general manager of the Dalmine company is president.

THE FOUNDRY TRADE JOURNAL offers congratulations to the (South African) *Engineer and Foundryman*, on the attainment of its 21st year of publication. The current issue is devoted to surveying the great progress that the South African engineering and metallurgical industries have made during the period covered.

A CONTRACT VALUED AT £500,000 for coal-handling plant for Drakelow "B" Power Station, Burton, has been awarded to International Combustion Products, Limited, a subsidiary of International Combustion (Holdings), Limited, Derby, by the Central Electricity Authority. The plant will be manufactured at Derby.

NEW laboratories of the National Coal Board's Mining Research Establishment at Isleworth were opened by Sir James Bowman, chairman of the board, on July 17. The completion of the laboratories marks the final stage in a programme of converting what was formally a film studio into a research establishment.

UNDER NEW PENSIONS PROPOSALS to be introduced by the Steel, Peech & Tozer branch of the United Steel Companies, Limited, Rotherham, increased death benefits for workpeople will be available. They have been achieved by converting the existing scheme into a pension fund in accordance with changes in the taxation law, thereby causing considerable savings.

UNDER THE CHAIRMANSHIP of the Minister of Housing and Local Government, Mr. Henry Brooke, the first meeting of the Clean Air Council was held on July 11. The first provisions of the Clean Air Act came into force at the beginning of the year and the Government proposes that the remaining provisions should come into force in the first half of 1958.

NIGERIAN EMPLOYEES of the Yorkshire Copper Works, Limited, Leeds, were presented to Sir James Robertson, the Governor-General of Nigeria, when he and Lady Robertson made a tour of the works on July 13. The company, which employs about 56 coloured people, is engaged in a joint venture with the Nigerian Government and the United Africa Company, Limited.

"HOLIDAY WITH A PURPOSE" for about 100 apprentices from the various works of Richard Thomas & Baldwins, Limited, began on Monday. They will visit Denmark where they will follow RTB steel and tinplate, which some of them have helped make, into Danish customers' plant, see something of Danish industry, and they will also visit Sweden and much of Zeeland.

THE Pulsometer Engineering Company, Limited, Reading, has acquired the whole of the issued share capital of the Self-Priming Pump & Engineering Company, Limited, Slough. Mr. F. B. Duncan, chairman, and Mr. J. S. Woodrow, managing director of Pulsometer, have joined the board of Self-Priming. Considerable benefits and economies are expected to result from the merger.

IN HIS ANNOUNCEMENT in the House of Commons on July 15 on the future of Britain's 24 ordnance factories, Mr. Aubrey Jones, Minister of Supply, said that Babcock & Wilcox, Limited, had decided, in principle, to acquire the Dalmuir factory and to feed in its own work as defence came to an end. The Minister said he expected very shortly to complete with the company the detailed negotiation of terms.

AMONG THE EXHIBITORS at the British Trade Fair and Exhibition to be held in Helsinki from September 6 to 22 will be Firth-Vickers Stainless Steels, Limited, Sheffield. The company will also be showing a representative selection from the extensive range of "Staybrite" stainless, heat- and corrosion-resisting steels, at the Brewers' and Allied Traders' Exhibition at Olympia, London, from September 30 to October 4.

A NEW JOINTLY OWNED COMPANY, De Laval-Holroyd, is to be formed by John Holroyd & Company, Limited,

News in Brief

machine-tool and gear manufacturers, of Milnrow, near Rochdale, and the De Laval Steam Turbine Company, of Trenton, New Jersey, United States. The company is being formed to allow the immediate marketing and subsequent manufacture in the US of the Holroyd range of worm gears and worm speed reducers.

THE IRON AND STEEL INSTITUTE is holding a special meeting in Belgium and Luxembourg from June 18 to 28, 1958. In honour of the Institute's visit, the *Centre National de Recherches Metallurgiques*, the *Groupement des Industries Siderurgiques Luxembourgeoises*, and the *Groupement des Hauts Fourneaux et Acieries Belges* are organizing an international iron and steel meeting on the general theme of "New Developments in Iron and Steelmaking."

WILLIAM H. CAPPER & COMPANY, LIMITED, announce that as from July 1, the sales and advertising policy of the company is being directed from Mayfair House, 9, Hertford Street, London, W.1, the premises at 1 and 3, Elliott's Place, Colebrook Row, London, N.1, are being retained as the site of its London works and the headquarters of the Capper Pipe Service & Welding Company, Limited, a subsidiary company concerned with contracts involving erection.

THE DEPARTMENT OF INDUSTRIAL ENGINEERING of the Loughborough College of Technology, announces that the National Council for Technological Awards has recognized the first four years of their five-year sandwich course as leading to the diploma in technology (dip.tech.(Eng.)), in production engineering. Further particulars may be obtained from the head of the Department of Industrial Engineering, Loughborough College of Technology, Loughborough, Leicestershire.

F. C. LARKINSON, LIMITED, Biggleswade (Beds), has received the contract to dismantle the Central Electricity Authority's Queensferry Power Station in Flintshire. The operations, which have begun, are expected to yield approximately 3,000 tons of scrap metal. The company has bought the whole of the installation, including coal conveyors, railway-wagon tipplers, overhead-travelling cranes, boiler plant, and so on. In addition, the purchasers propose to dismantle the two self-supporting steel chimneys, which are in the region of 100 ft. high.

THE ANNUAL WORKS EXCURSION of Matthew Swain, Limited, ironfounders, Newton Heath, Manchester, was held on July 6, when approximately 200 employees were the company's guests for the day at Blackpool. After luncheon, the chairman of the company, Mr. Matthew A. Swain, made presentations in recognition of 25 years service with the company to Mr. H. Ashton, Mr. F. Dawes, Mr. L. Hinchley, jnr., and Mr. J. Whittall. The service for 35 years of Mr. W. Birtles and Mr. H. Earnshaw was also honoured.

MASSEY-HARRIS-FERGUSON, LIMITED, of Canada, has made an offer worth over £10,500,000 for all the ordinary stock of the Standard Motor Company, Limited. The offer is one no par value share of common stock of Massey-Harris-Ferguson for every eight stock units of 5s. in the ordinary capital of Standard Motors, plus a cash payment of 1s. 6d. for every stock unit of Standard Motors. Lord Tedder, chairman of the Standard Motor Company, said he welcomed the proposal as the natural development of the present association between the two companies.

A NEW SUBSIDIARY COMPANY, West's (Manchester), Limited, formed by West's Gas Improvement Company, Limited, Manchester, will deal with activities outside the gas industry which have hitherto been carried on by the parent organization, and will include the production and marketing of screening plant, mechanical-handling equipment, and coal-preparation plant, as well as design and manufacture of Flämrich PSH resonance screens, Wemco coal-preparation plants, and other items in the Wemco range. The address of the new company is Norton Street, Miles Platting, Manchester, 10 (telephone: COLlyhurst 2132).

BIRMINGHAM ENGINEERING AND ALLIED EMPLOYERS' ASSOCIATION, which celebrates its diamond jubilee this year, has moved to newly-built headquarters at St. James's House, Edgbaston. The premises are the first of any considerable size outside London, it is believed, to be specially designed to promote and foster industrial relations between employers and employees. The Association has developed from some 20 member-firms to 700 with a total labour force of about 400,000. Membership is still growing and already is by far the largest of any of the 40-odd provincial associations affiliated to the Engineering and Allied Employers' Federation.

Sir ANDREW NOBLE, Ambassador to Mexico, urged industrialists, on July 12, to renew efforts to increase export markets in Mexico and to consider establishing new subsidiary firms there or going into partnership with Mexican companies. Sir Andrew was speaking in Birmingham at a meeting of the Chamber of Commerce, and he stressed that the aim of industry here should be to raise British exports to Mexico from the £9,400,000 last year to an annual £38,000,000, equal to 10 per cent. of the total import market. He reminded manufacturers that the Mexican Government allowed subsidiary firms in certain industries to remain free of income tax for ten years.

A STATEMENT ISSUED BY Leyland Motors, Limited, claims that the group at present accounts for 10 per cent. of the world's total export of heavy-diesel commercial vehicles. The output of complete chassis from Leyland's Lancashire factories increased during the first six months of this year by 17 per cent. over the same period last year, which, in itself, was 13 per cent. higher than the first six months of 1955. This high rate of production has been partially attained by a steady flow of modern machine-tools into the existing factories and by a slight re-disposition of machining lines including an additional machine-shop bay. Greater mechanization has also been introduced in the iron and steel foundry to step-up the output of castings.

THE COBALT INFORMATION CENTRE, at the Battelle Memorial Institute, has announced the publication of its new reference bibliography, "*Cobalt and Its Alloys, a Summary on Allotropy and Phase Diagrams.*" The 100-page bibliography which contains several hundred references to cobalt literature, as well as two-colour phase-diagrams of numerous binary alloy systems, is one of a series of publications being prepared by the Cobalt Information Centre to aid users of the metal. It is available to persons writing directly to the Cobalt Informaion Centre at Battelle. (London office, 24 Ryder Street, St. James's, S.W.1.) The Cobalt Information Centre was established at Battelle in mid-1956. Its purpose is to encourage cobalt research and development, to distribute technical information on the metal, and to provide technical aid to users. The Centre is supported by an international association of cobalt producers.

Company News

E. J. & J. PEARSON, LIMITED, refractory manufacturers, of Stourbridge (Worcs)—In response to the offer by J. T. Price & Company, Limited, refractory manufacturers, of Stourbridge, for the company's ordinary stock, acceptances totalling approximately 97.3 per cent. have been received.

CALEDON SHIPBUILDING & ENGINEERING COMPANY, LIMITED—The entire scheme of modernization should be completed within a few months, but progress in the year to March 31, 1957, has immensely improved facilities. Group net profit was £91,187 (£91,469) and the ordinary dividend is increased by 3 to 8 per cent.

ASSOCIATED BRITISH ENGINEERING, LIMITED—Turnover was well maintained, but it was not possible fully to recover in selling prices, particularly in export markets, the steadily rising costs of materials and wages. Group trading profits at £440,927 declined by £93,686, but are £124,459 higher than for 1955. The dividend on the £1,057,890 ordinary capital is maintained at 10 per cent. with an unchanged final of 6 per cent.

WOLVERHAMPTON METAL COMPANY, LIMITED—The group is still faced with the problem of increasing scarcity of raw materials and there has been a tendency towards narrower margins due to keen competition. Trading conditions are less favourable than last year and if they continue it may be impossible to maintain the high level of profits—£627,162, an increase of £16,683. The dividend is maintained at 27½ per cent.

AMALGAMATED METAL CORPORATION, LIMITED—World consumption of metals (except USA zinc) kept up at 1955 high levels. Demand from the motor-car industry was lower, but manufacture of wire and cables to serve the non-stop growth of the electrical industry was greater than ever. Group profits, before UK tax, was £1,281,405 (£1,466,535), and the dividend is maintained at 10 per cent.

YORKSHIRE COPPER WORKS, LIMITED—An unchanged interim dividend of 6 per cent. is declared; the final is 6 per cent., plus a bonus of 3 per cent. for the year to July 31, 1956, making a total of 15 per cent. The directors state that while the works have been and are being fully employed, the profits for the current year, owing to the reduction in profit margins, are likely to be appreciably less than those for the previous year. So far as can be seen at present, they add, this is not likely to place the final dividend in jeopardy.

HILLS (WEST BROMWICH), LIMITED, manufacturers and engineers to the building trades—The company is not declaring an interim dividend for the year to July, 31, 1957. (A 6 per cent. interim and a 12 per cent. final were paid for 1955-56). Substantial losses were suffered during the 10 months to May 31, 1957, as a result of the credit squeeze which brought cancellations and deferment of projects. Reorganization is proceeding to meet the situation—including reconstruction of the order-book—and while considerable savings have already been made, the value of these will not become wholly apparent during the present financial year.

RICHARDSONS, WESTGARTH & COMPANY, LIMITED, engineers, ironfounders, etc., of Wallsend on Tyne—It is proposed to apply for CIC permission to capitalize part of the reserves, and investigation of the most suitable form the additional permanent capital needed should take is proceeding. The complete schemes of extension and modernization will shortly raise the group's capital expenditure programme to some £6,000,000 to extend over the next four years. Orders on hand exceed £40,000,000 value exclusive of the recently acquired Humber Graving Dock & Engineering Company, Limited, and Parsons Marine Turbine Company, Limited.

Beyer, Peacock Bid

An offer for the whole of the 4,000,000 2s. ordinary shares of the Anti-Attrition Metal Company, Limited, has been made by Beyer, Peacock & Company, Limited, locomotive engineers, steel, brass, and iron founders, of Gorton, Manchester. The offer is on the basis of one £1 ordinary share in Beyer, Peacock & Company for every 20 ordinary 2s. shares of Anti-Attrition and a cash payment of 3d. for each ordinary share of the company.

In recommending acceptance, the board of the Anti-Attrition Metal Company says that the outlook for the company as a separate entity is restricted by lack of adequate liquid capital which necessitates curtailment of essential expenditure. Production is running at approximately the same rate as for the corresponding 1955-56 period, but profits are less due to lower margins resulting from the decline in metal prices.

Mr. S. J. Patmore, a shareholder in Anti-Attrition, is to urge fellow shareholders to reject the offer. Following discussions with a number of substantial shareholders he considers the offer "far too low in relation to the company's assets. On the basis of the current market price of Beyer, Peacock shares, he calculates the bid for Anti-Attrition is worth about £500,000, and he maintains that the factory and offices at Maidenhead are alone worth nearly this figure. He is also seeking support for the formation of a committee of shareholders.

Metal Industries Recovery

Heartening recovery from a loss of £544,923 to a profit of £1,627,359—almost equal to the highest profits ever made in the history of the company—is reported by Sir Charles Westlake, chairman of Metal Industries, Limited, in his annual review. Sir Charles is by no means convinced that the profits of subsidiaries are the best that could be achieved.

Capital commitments total about £150,000, but since the date of the accounts authority has been given for further substantial capital expenditure in respect of certain subsidiaries. Group net current assets rose from £4,546,209 to £5,877,665, and bank overdrafts fell from £1,434,619 to £182,673, largely as a result of the sale of Sentinel (Shrewsbury), Limited. Some profitable investment for these funds in a sphere related to the other group activities is being sought. The net profit is £800,097 (£417,561 loss) and the distribution 14 per cent. (nil).

Record Sales of Edgar Allen

A record value of sales was achieved by Edgar Allen & Company, Limited, Sheffield, during the year to March 30, 1957. The turnover of the group and of the parent company in value advanced respectively by 15 per cent. and 12 per cent. Net profit was £257,150 (£192,653), and the ordinary dividend is held at 12½ per cent.

The directors report that demand for group products continues to be good, and is evidenced by the volume and value of orders on hand. The substantial increase in profit was achieved despite adverse conditions of cost, supply, and price, which affected the previous year's trading.

The raw-materials division of George Cohen Sons & Company, Limited, will be moving the headquarters to 600, Wood Lane, Shepherds Bush, London, W.12. (Telephone: Shepherds Bush 2070).

Personal

Mr. A. J. DILLINGHAM has resigned from the board of F. Perkins, Limited.

Mr. M. C. LLOYD, formerly works director of F. H. Lloyd & Company, Limited, near Wednesbury, Staffs, has been appointed assistant managing director.

Mr. HAROLD F. BAGSHAW, who recently retired from his post as mills manager of Brown Bayley Steels, Limited, Sheffield, has been presented with a cheque by the staff and management.

Lt.-Col. V. I. ROBINS, who has been secretary since 1926 and a deputy director since 1952 of the National Union of Manufacturers, has been appointed a director in place of Mr. C. F. V. WILLIAMS who has retired.

Mr. M. SEAMAN, has moved from the board of British Oxygen Engineering, Limited, to the board of British Oxygen Gases, Limited, with whom he will be the director responsible for equipment manufacture.

Mr. WALTER BRINDLEY has been appointed managing director of Dartmouth Auto Castings, Limited, of Smethwick, Staffs. Mr. A. E. PEARCE, who has been a director of the company since its inception in 1934, is to retire this month.

Sir CHARLES NORRIS has been selected to succeed Sir THOMAS HUTTON as director of the British Productivity Council early in the autumn. Sir Charles has held appointments at the Admiralty and has been concerned with the introduction of work-study into naval establishments.

Major W. A. WEAVER, managing director of the Coventry Victor Motor Company, Limited, has been elected president of Coventry Engineering Society in succession to the late Sir Alfred Herbert who held the office for more than 50 years. Major Weaver was deputy president.

Two British students—Mr. EDWARD L. LEWIS and Mr. R. D. NELSON—were among the 14 winners of an international essay competition who received their prizes at a recent ceremony in Bruges, presided over by Mr. Fernand Dehousse, president of the Council of Europe's Consultative Assembly.

Mr. PERCY CLEYDON has retired from his post of welfare and social manager of the Standard Motor Company, Limited, Coventry, and on July 19 received gifts from colleagues at a farewell ceremony. Mr. H. S. Weale, a director, presented him with a television set as a gift from the staff.

Mr. FREDERICK PICKWORTH, chairman of the English Steel Corporation, Limited, Sheffield, was knighted by the Queen at last week's investiture at Buckingham Palace. Sir Frederick and Lady Pickworth and members of their family held a celebration luncheon in the West End after leaving the Palace.

Mr. W. W. HACKETT, chairman of Accles & Pollock, Limited, Oldbury, celebrated his diamond wedding on July 19. Mr. Hackett, now aged 83, joined the firm at the age of 20. He was awarded the O.B.E. for his invention, during the war, of a technique for mass-producing the barrels of sub-machine guns.

Mr. W. J. BLOIS JOHNSON, formerly of Mather & Platt, Limited, Manchester, has been appointed export manager of the A. P. V. Company, Limited. Mr. K. A. GROVER, who has been the company's accountant since 1956, has been appointed secretary in succession to Mr. A. C. Furse-Roberts, who has left the company.

Mr. P. F. EISLER has been appointed export sales manager of the tractor division of David Brown Industries, Limited, Meltham, near Huddersfield. He will be concerned with the export of David Brown tractors and David Brown Albion agricultural machinery. Formerly European sales manager, Mr. Eisler has been with the David Brown company for eight years.

YORKSHIRE RANGE COMPANY, LIMITED, Prospect Foundry, Shipley, Yorks, announce that resulting upon the resignation of Mr. C. LEONARD WILSON as chairman, the following appointments have been made:—Mr. C. DUANE, A.M.C.T., is the new chairman, Mr. B. KITSON, managing director, and Mr. F. W. MARSHALL, Mr. E. S. MARSHALL, and Mr. W. NICHOLSON are members of the board.

Mr. PAUL GOUDIME, managing director of Electronic Instruments, Limited, is the new president of the Scientific Instrument Manufacturers' Association. The retiring president, Mr. G. A. WHIPPLE, chairman and managing director of Helgar & Watts, Limited, now becomes vice-president, and Mr. R. BARRINGTON BROCK, a director of Townson & Mercer, Limited, now a vice-president of the Association is president-elect.

Mr. N. PICKLES has been appointed manager of the Lincoln branch office of British Insulated Callender's Cables, Limited, in succession to Mr. A. S. Gee, who has retired. Mr. Pickles, who joined Callender's Cable & Construction Company, Limited, in 1924, was transferred to the Nottingham sales office in 1930, serving there until 1939. He then transferred to the Sheffield colliery contracts and sales office. After war service he joined the Leicester branch office as representative.

Mr. C. R. BRYANT, Mr. F. L. JOHNSON, and Mr. T. NOBLETT have been appointed managers of the Manchester, Blackburn, and Preston offices, respectively, of British Insulated Callender's Cables, Limited. Mr. Bryant, who joined the staff of the former British Insulated & Helsby Cables, Limited, in 1920, has been manager of the Blackburn office since 1953. Mr. Johnson, who succeeds Mr. Bryant at Blackburn, has been with the company since 1925 and has been engaged in general sales for the last two years. Mr. Noblett's appointment follows the creation of a branch office at Preston, where previously there has only been a depot.

Board Changes

A. P. V. COMPANY, LIMITED—Mr. H. P. N. Benson, formerly managing director of Waring & Gillow, Limited, has been appointed a director. Mr. William E. Jenkins, who until his recent retirement was managing director of the Esso Petroleum Company, Limited, has been appointed a director, and will act in an advisory and non-executive capacity.

HAWKER SIDDELEY GROUP, LIMITED—Mr. H. G. Herrington, managing director of High Duty Alloys, Limited, and chairman of the Templewood Engineering Company, Limited, and Mr. G. C. R. Eley, chairman of the Brush Group, Limited (recently acquired by the Hawker Siddeley Group), and of Richard Crittall & Company, Limited, have joined the board.

Obituary

The death occurred in New York on July 16 of Mr. WALTER C. KERRIGAN, assistant to the president of the International Nickel Company of Canada, Limited. He was 65. Mr. Kerrigan joined the nickel sales department of the International Nickel Company, Inc., in 1930 and became manager in 1946. In 1952 he was elected vice-president and general sales manager.

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Raw Material Markets

Iron and Steel

Up to the end of August the foundries will be taking their annual holidays, but the reduction in output of castings is not likely to cause any serious difficulty as production schedules are generally up to date and most consumers will also be on holiday. In the majority of cases deliveries of pig-iron and other raw materials will not be accepted during the closure. Apart from concern regarding increasing production costs and the pending rise in iron and steel prices, there is little change in the position at the ironfoundries.

Foundries supplying castings to the motor-car trade continue to benefit from the improvement in that industry and have stepped up their demands for pig-iron appreciably—so much so that if requirements continue at present levels, difficulty may be experienced in obtaining the quantities of low-phosphorus irons required. Other users are also taking up good tonnages for the production of high-duty castings for many other trades, including machine-tool makers, power and electrical plant manufacturers, general engineering trades, etc.

Hematite pig-iron, production of which is on a much larger scale, is being obtained in the quantities specified, and refined irons can also be obtained fairly easily. High-phosphorus pig-iron is the most plentiful, producing furnaces having tonnages to spare. Only moderate demands come from the light and textile foundries, but some of the engineering foundries are taking up good tonnages as well as the jobbing foundries, which have a fair amount of work on hand.

The steelworks continue to be the major consumers of pig-iron and, with the expansion in supplies of basic iron from home producers, they are not so dependent on imported material, although these deliveries are still at an appreciable level. All grades of home-produced pig-iron are available for export when production and licences permit. Hematite, which has recently been added to the list, is being offered in limited quantities. Increased tonnages of high-phosphorus iron are being shipped abroad, but home demands are likely to absorb nearly all the low-phosphorus irons.

The foundries are well supplied with scrap, the chief demand being for the heavier and better grades of cast iron and machinery scrap. Foundry coke is coming forward in sufficient quantities to provide some stocks, and ganister, limestone, and firebricks are available as needed.

The re-rollers maintain a steady demand for billets, although some have still good stocks on hand from oversea consignments, and they are not taking up all the tonnages on offer from home steelworks. Deliveries from home sources are on a good scale and appear sufficient to meet present needs, apart from carbons and special quality steels. The re-rollers are able to maintain good outputs of small bars and light sections, demands for which have shown a slight improvement. Sheet and strip re-rollers are also obtaining improved business, and the heavy demand for reinforcing rods continues.

Non-ferrous Metals

The unilateral strike action taken by European rock-breakers on the Northern Rhodesian Copperbelt at the end of last week may very well result in the closing down of the copper producers. The rockbreakers, who blast the underground ore, are demanding a six-hour day on Saturday rather than the usual eight-hour shift. The trouble apparently stems from the fact that certain underground workers are allowed to work a six-hour shift on Saturdays on the condition that this two-hour loss of time is made up during the week. This is not possible for the rockbreakers to achieve and the mines are refusing to meet their claims and have stated that unless they were prepared to work a full shift the mines would have to be closed down.

This action put the London copper market several points better on Monday. A total cessation of copper production on the Copperbelt is certainly a bullish factor. But it has only just come in time to save the quotation from going lower. This would have undoubtedly been the case following the lowered Belgian Congo price on last Friday from 31½ fcs. to 30½ fcs., which was followed over last weekend by the drop in the custom smelter price ¼ cent to 28¼ cents per pound at which level fair activity has been reported. The export price followed suit and dropped the same amount to 27¼ cents, but the producers' price remains at 29¼ cents a pound, with scrap trading around 22¼ cents a pound.

Tin has been a weak market, although the undertone is reasonably firm. There has been some Continental inquiry, but prices have drifted largely due to the accretions to stocks, the buffer stock manager being out of the market, the improvement in the Singapore Harbour dispute, and some fairly heavy selling from so called influential quarters. In the US the price is about 96 cents a pound.

Lead is inactive on both sides of the Atlantic. Holidays are a restraining factor and the London market is practically at a standstill. In the US the price remains at 14 cents a pound.

The low price of zinc—10 cents a pound in America—is still repercussing on the US mining industry, the latest victim being the US Steel Corporation's zinc mines at Jefferson. These are being placed on a four-day instead of a five-day working week. The reason given is that industry is unable to absorb the output of zinc concentrate. In London the market is steady though featureless, with a backwardation tendency.

Steel Output in 1957

The weekly rate of steel production in June was affected by the Whitsun holiday break and fell to 418,700 tons, compared with 443,200 tons in the previous month and 379,700 tons in June, 1956. The Iron and Steel Board announces that production for the first half of this year was 11,140,000 tons, an increase of 5.1 per cent. on the 10,600,000 tons produced in January-June, 1956.

The table below gives the latest steel and pig-iron output figures (in tons) and compares them with earlier returns.

Period.	Pig-iron.		Steel ingots and castings.	
	Weekly average.	Annual rate.	Weekly average.	Annual rate.
1957—March	277,200	14,415,000	431,000	22,411,000
April	277,400	14,425,000	430,000	22,360,000
May	283,500	14,742,000	443,200	23,046,000
June	274,600	14,282,000	418,700	21,771,000
Half year ..	272,700	14,179,000	428,600	22,285,000
1956—March	262,000	13,624,000	425,800	22,141,000
April	254,300	13,225,000	421,100	21,896,000
May	246,500	12,820,000	396,400	20,612,000
June	239,600	12,459,000	379,700	19,744,000
Half year ..	254,500	13,232,000	407,600	21,196,000

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Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered unless otherwise stated*)

July 24, 1957

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £20 1s. 0d.; Birmingham, £19 13s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £21 18s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £22 2s. 3d.

Scotch Iron.—No. 3 foundry, £23 4s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £24 6s. 6d.; South Zone, £24 9s. 0d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £25 14s. 0d.; South Zone, £25 16s. 6d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £22 17s. 6d.; Scotland (Scotch iron), Zone S. 1, £23 4s. 0d.; Sheffield, £24 4s. 6d.; Birmingham, £24 12s. 0d.; Wales (Welsh iron), £22 17s. 6d.

Basic Pig-iron.—£19 3s. 0d. all districts.

FERRO-ALLOYS

(*Per ton unless otherwise stated, delivered*)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £50 0s. 0d. to £53 5s. 0d., scale 17s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £76 7s. 6d., scale 17s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 28s. 6d. per lb. of V.

Ferro-molybdenum.—65/70 per cent., carbon-free, 12s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 9s. 8d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 12s. 8d. per lb. of W.

Ferro-chrome (6-ton lots and over).—4/6 per cent. C, £96 0s. 0d. to £99 10s. 0d., basis 60 per cent. Cr, scale 33s. 0d. per unit; over 6 per cent. C, £94 0s. 0d., basis 60 per cent. Cr, scale 31s. 0d. to 33s. 0d. per unit; 2 per cent. C,* 2s. 2d. per lb. Cr.; 1 per cent. C,* 2s. 2½d. per lb. Cr; 0.15 per cent. C,* 2s. 3d. to 2s. 3½d. per lb. Cr; 0.10 per cent. C,* 2s. 3¼d. to 2s. 3½d. per lb. Cr; 0.06 per cent. C,* 2s. 3½d. to 2s. 4d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 0d. to 7s. 6d. per lb.

Metallic Manganese.—90/92 per cent., carbon-free, £290 0s. 0d.; 96/98 per cent., £310 0s. 0d.

Ferro-columbium.—65/75 per cent., Nb + Ta, 22s. 0d. to 23s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £82 12s. 6d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £30 9s. 0d.; tested, 0.08 to 0.25 per cent. C, £31 9s. 0d.; hard (0.41 to 0.60 per cent. C), £32 10s. 6d.; silico-manganese, £41 0s. 0d.; free-cutting, £34 13s. 0d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £38 4s. 6d.; silico-manganese, £41 7s. 6d.

* Average 68-70 per cent.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £36 3s. 6d.; basic, hard, over 0.41 up to 0.60 per cent. C, £37 6s. 0d.; acid, up to 0.25 per cent. C, £40 7s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £39 2s. 0d.; boiler plates (N.-E. Coast), £41 12s. 0d.; floor plates (N.-E. Coast), £40 11s. 0d.; sectional material, N.-E. Coast, £37 11s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested (4-ton lots), £37 18s. 0d.; flats, 5 in. wide and under (4-ton lots), £37 18s. 0d.; hoop and strip, £37 17s. 6d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £41 6s. 0d.; black sheets (hand mill), 17/20 g., £52 4s. 6d.; galvanized corrugated sheets, 24 g., £64 1s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £65 10s. 3d., nickel-chrome, £92 13s. 0d.; nickel-chrome-molybdenum; £104 11s. 6d.

NON-FERROUS METALS

Copper.—Cash, £216 15s. 0d. to £217 0s. 0d.; three months, £219 10s. 0d. to £219 15s. 0d.; settlement, £217 0s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 2s. 1d. per lb.; rods, 245s. 0d. per cwt. basis; 20 s.w.g., 278s. 3d. per cwt.

Tin.—Cash, £746 10s. 0d. to £747 0s. 0d.; three months, £743 10s. 0d. to £744 10s. 0d.; settlement, £744 0s. 0d.

Lead (Refined Pig).—Second half July, £90 0s. 0d. to £90 10s. 0d.; second half October, £91 0s. 0d. to £91 5s. 0d.

Zinc.—Second half July, £74 0s. 0d. to £74 5s. 0d.; second half October, £73 10s. 0d. to £73 15s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £108 15s. 0d.; rolled zinc (boiler plates), all English destinations, £106 10s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £90.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 8¼d. per lb.; rods, drawn, 2s. 11d.; sheets to 10 w.g., 183s. 9d. per cwt.; wire, 2s. 5¼d.; rolled metal, 183s. 9d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £148; B6 (85/15), — ; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £206; HTB2 (38 tons), — ; HTB3 (48 tons); — .

Gunmetal.—BS1400, LG2 (85/5/5/5), £190; LG3 (86/7/5/2), £200; G1 (88/10/2/½), £260; (88/10/2/1), £253.

Phosphor Bronze.—BS1400, PB1 (AID released), £280 per ton.

Phosphor Bronze Strip, etc.—Strip, 267s. 9d. per cwt.; sheets to 10 w.g., 287s. 0d. per cwt.; wire, 3s. 9½d. per lb.; rods, 3s. 1¾d.; tubes, 3s. 1¾d.; chill cast bars: solids 3s. 1½d., cored 3s. 2½d. (CHARLES CLIFFORD, LIMITED.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 8d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 0¾d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 11¾d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 5½d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £87 0s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £197 0s. 0d.; aluminium bronze (BS1400), AB1, £241; AB2, £258.